

IN FOCUS: IN THE ROUGH — OFF-ROAD ADVENTURING

TECH » SCIENCE » WHEELS » HOME » OUTSIDE

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20
SNAP WEATHER
FORECASTERS



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Popular Mechanics

10 TECH
CONCEPTS
FOR 2012

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ODYSSEY**
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EDITOR'S NOTES

A SECRET HUMAN COLONY ON MARS? WE KNEW IT

A few weeks ago, I complained to a friend about the bizarre priorities of our popular media, lamenting the fact that a weird UFO conference late last year (you know, alien abductions, secret human bases on Mars, ET visitations, etc) had attracted more press attention than the 63rd International Astronautical Congress in Cape Town, an event of real significance. Were their perceptions of space exploration and astrobology horribly skewed, or was it no more than a harmless attempt to "lighten up" their content?

Perhaps it was me who needed to lighten up, he suggested. After all, people had always believed in things they couldn't see or touch. Was there any harm in revelations about the hidden codes of our DNA, secret treaties between governments and aliens, Bigfoot, yeti, and (I'm not making this up) Orbitally Rearranged Monoatomic Elements?

In a word, yes. Science-encompassing quantum physics, cosmology, genetics and the myriad other disciplines that help to explain how life and the Universe work – is already weird and exciting, and it certainly doesn't need the distraction of loony theories. If you'd like to explore a few specifics, spend an illuminating hour with Google and look up "quantum entanglement", "double slit experiment", "dark energy", "first life on Earth", Schrödinger's cat", and – if you're feeling strong – "string theory". As for tantalising hints of the long-sought Higgs boson, well, that's about as far out as it gets.

We generally avoid becoming embroiled in debates on ET, but it has to be said that RamsayMedia's year-end party provided strong evidence of extraterrestrial infestation, as evidenced by this damning image of *Getaway* magazine publisher Jacqueline Lahoud "bonding" with an alien (aka PM's associate editor, Sean Woods). Editor Alan Duggan elected to be cropped from the picture in the interests of public decency.

Here's an interesting diversion: we're told that if a piece of neutron star the size of a 10c coin were to land on Earth, it would weigh about 100 million tons. Fortunately, according to ancient texts unearthed at the junction of ley lines near Avebury, this is unlikely to happen before 6 pm on 14 October 2034*, by which time we should have solved the mystery of what really happened in Area 51.

On to this month's issue, and a slightly alarming cover story about digital espionage. It's bad enough when foreign hackers invade our economic and military territories to steal valuable information, but when they launch assaults on our personal privacy, it becomes offensive and downright scary. Read "The secret war" (page 20) and be afraid.

Alan Duggan

aland@ramsaymedia.co.za

* Actually, I made this up.



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COMPETITION WINNERS... Details online at www.popularmechanics.co.za



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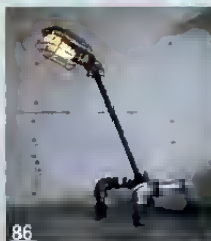
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Cover: Supporting an undeclared war, digital spies have their eyes on all manner of industrial and military secrets, and may even be looking at you. Illustration: Andrey Prokhorov/Stock Photo. This page: Although its bid for a sailboat speed record didn't quite go according to plan, the Vestas SailRocket 2 remains a formidable contender.

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Go on, switch to gas

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solve problems,
geniuses
prevent them."

albert einstein

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PUBLISHED BY: RamsayMedia (Pty) Ltd
Chairman: Alan T Ramsay
Managing Director: Stuart Lowe
Directors: Terry Moolman, Gordon Utavi, Brian Burnett, James Eades,
Simon Turck, Tim Holden, Peter Venn
HR Executive: Amanda Kirk



Total monthly sales: 43 583 (July to September 2011)

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Company registration number: 1934/005460/07, ISSN number: 1682-5136

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The LED Lenser X range

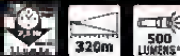
The X Series offers lamps for those who like superlatives. With these lamps, illuminating large areas and achieving impressive ranges are child's play.



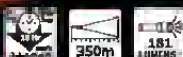
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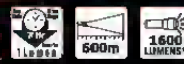
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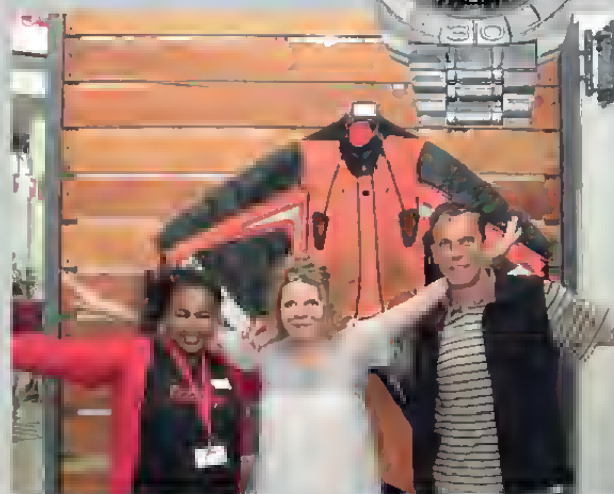
* Luminous flux (lumens) and max beam distance (meters) are measured in the brightest function when switching on with new set of fresh alkaline batteries. These are average values and may vary +/- 15% depending on type of chip and batteries.

** Average hours of burning life as measured in the least energy-consuming mode and until residual luminous flux amounts to 1 lumen.

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LETTERS

Winning letter



PM's promotions manager, Nomfundo Celene, with Meriana and Jey Louw at the 2010 Inventors Conference in Cape Town. The Louw family have attended all three conferences.

BRING ON INVENT 2012

A big thank you from us for "inventing" the annual Inventors Conference. Ever since we attended the first conference back in 2009, this colourful end inspiring event has become an absolute must-do on our family's annual calendar. What we've loved most has been the diversity and richness of minds, concepts and thoughts being brought together in one place, combined with some very honest sharing from the many remarkable innovators and inventors in attendance.

Our conference continues in the car on the way home as we share, compare and highlight our best moments of this inspiring annual get-together, after which the bright ideas follow (or half-bright, mostly). Thanks for the effort and for the organisation. We're ready to invent, ready to diarise Invent 2012!

AY MARIANA, DALE AND DEAN LOUW
VIA E MAIL

Write to us, engage us in debate, and you could win a cool cool prize; this month's best letter wins a thoroughly desirable CAT watch worth R1 995. As evidenced in this watch, CAT Timekeeping Equipment reinvents and contextualises the heritage and authenticity of the brand's core know-how – clean and urban, encased in finely engineered stainless steel, and equipped with a technically advanced movement. For more information, contact S Bacher & Co on 011-372 6000 or visit www.sbacher.co.za

Send your letter to: Popular Mechanics, PO Box 180, Howard Place 7450 or e-mail popularmechanics@ramsaymedia.co.za. Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.



Great minds, great event

I must thank you for the invitation (to the 2011 Inventors Conference) and for the opportunity to spend time with some of our country's great minds. The event was awesome... comparable with some of the best meetings in the global environment of biotechnology that I have attended while working in Switzerland. Thank you, too, for the great magazine that you publish. I look forward to many more exciting and fun years with you guys.

MARK ROELL
CNC INSTRUMENTS

Thanks for the memories

It (PM's "Inventor of the Year" awards function) was a memorable evening, and the pictures (see our Facebook pages) show the culmination of a job well done. (PM editor) Alan and his team have given us such wonderful memories. From me to all the finalists, and to all those who submitted their work for consideration, I am very proud to be counted among you. Your work is different from mine, but just as important to the development and furtherance of science, innovative thinking and technology. I will cherish the moments I spent with all of you in Johannesburg.

GEORGE VICATOS
CAPE TOWN

Editor's note: Dr Vicatos was named Inventor of the Year at our awards function on 24 November; you can read about it elsewhere in this issue. He was subsequently awarded a top-up to his R50 000 prize in the form of R50 000 worth of design and development support from the Vaal University of Technology (VUT), through its Technology Transfer and Innovation Directorate.

It worked for me

The PM Inventors Conference was truly inspirational – a watershed moment for creative minds that allowed us to explore the potential of our dreams and advance our prospects. The various presenters defined the path a designer, inventor or entrepreneur would likely travel in nurturing their idea into existence.

Our great challenge now is to fully explore and exploit the commercial opportunities for Ecotake, and with the acknowledgement conferred by your "Going Green" accolade, our energy has been catapulted in the right direction. I would like to acknowledge the PM team – yourself, Brandon, Sean, Alastair, Nomfundo and the numerous behind-the-scenes contributors – who waved their magic wands to create a fantastic event.

JAMIE HAMLIN
SOMERSET WEST

Goodbye, Garden of Eden?

Michael Shermer calculates that humans have created about 10 000 different religions and about 1 000 gods ("A trick of the mind", December 2011). Perhaps so, but these weren't separate notions independently plucked out of thin air. Human beings communicate, and our religions have borrowed from each other and compete; they have evolved. And we live successfully in a mysterious world.

Technological evolution explores what is possible in that part of the world we can experiment with, and religions explore our relationship with what we can't experiment with – something that is greater than us. Part of the mystery of God is expressed in our ignorance of the future – a future in which the threats are more profound. We're no longer afraid of the Syrian king taking our city, but of a nuclear winter freezing us or global warming boiling us, and taking out the Garden of Eden along with human civilisation. This isn't a good time to be so cock-sure (as Shermer is) about the absence of God. Along with the ability to reason, we need more God-fearing, not less.

JONATHAN JACKSON
VIA E-MAIL

Mac vs PC: Round II

I switched to Apple Mac a couple of years ago after suffering under Windows for the previous 20 years. Your comparison



Right place, right time

A word of thanks for last night's PM preview of *Real Steel* in Cape Town, a movie that delivers a big punch (duh) in more ways than one. We sneaked in under false names when my cousin and his partner couldn't make it – sorry! Anyway, my girlfriend came along under protest, complaining loudly until the film started, at which point she shut up and began to enjoy it.

Thanks to PM for giving us a good night out, and also for the Coke and popcorn. I saw afterwards that Barry Ronge (the respected *Sunday Times* movie critic) also enjoyed it, so I guess we were in the right place at the right time.

NICO KIRSTEN
DURBANVILLE

between Apple's OS and Microsoft's Windows (December 2011 issue) missed the Mac's real advantages over a Windows machine. These are:

- No viruses; hence, no need to spend money on anti-virus software that slows down your machine.
- No registry to get scrambled.
- No need to install software. With a Mac, you simply load it on to the Applications folder, and it runs when you need it.
- Near-zero crashes, and you need to re-boot only a couple of times a year.
- A Mac runs when you open it and stops when you close it; no BS.
- No need to hunt for drivers; the Mac offers real plug-and-play.

Any disadvantages? Only the cost. PCs are a bit like the Fortran programming language of the 1970s... a lousy option, but since the whole world was using it, we were stuck with it.

DION KRIGE
GALLO MANOR
SANDTON

Minds clanging shut?

In the January issue of your excellent magazine you added an editorial comment to a letter from Peter Darley on the subject of global warming. Perhaps you shortened his letter, but I could not find any reference in it to 9/11 to support your contention that he was proposing an alien conspiracy was behind all our woes. I could almost hear your mind clang shut in response to Mr Darley's quite sober and cogent comments on a subject which should properly exercise all our minds.

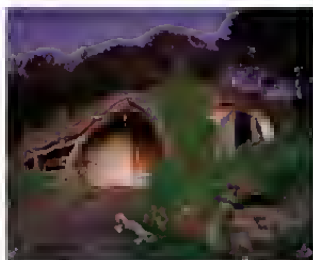
CHRIS DAMS
PRETORIA

Conduct unbecoming?

I refer to your riposte to Peter Darley's letter, "So global warming is a scam?" (January issue). The 9/11 event was enough of a tragedy without you making flippant and facetious reference to it. I feel that your remark was uncalled-for, unbecoming, and unworthy of a publication that prides itself on telling the truth, no matter how unpalatable, and I think you owe Mr Darley an apology. Climate change is not a scam, but global warming is.

CHRIS GRAHAM
RANDBURG

Editors' note: Somewhat embarrassingly, an acerbic footnote was wrongly appended to Mr Darley's letter. In fact, it was intended as a response to another reader's letter concerning UFOs and alien visitors (dropped at the last moment). We have apologised to him. If you would like the full text of these shortened letters, please e-mail kated@ramsaymedia.co.za



Of feet and feats

Although I lack the large and hairy feet of the authentic hobbit, I remain fascinated by their idyllic lifestyle – that is, when they're not off fighting orcs and performing feats of valour. You'll understand, therefore, why I fell in love with the Dale family's quirky eco-home in the Welsh countryside ("Natural living", December 2011 issue).

Although the plans accompanying your article were charmingly naive, I believe I've seen enough to be able to replicate their "hobbit house" on my property near Elgin, using materials from the immediate area. When it's complete, I'll get in touch.

MIKE DOHERTY
CAPE TOWN

Brutality alert!

Editor's note: Your letters are invariably interesting, but often far too long. To minimise the risk of brutal cuts, please keep them bright and tight.

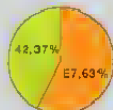
PM

MONTHLY POLL

PM subjected a Mac and a PC to a battery of tests to see which UI had the higher IQ (December 2011 issue). Which one do you swear by?

Mac is the best. Apple's latest OS X release, Lion, shows a heavy influence from iOS, the operating system found on iPhones and iPads. So cool!

PC all the way. I can't wait for the Windows 8 OS, expected in 2012, which is inspired by smartphones.



Conducted online at www.popularmechanics.co.za – visit PM's Web site to vote in our current poll.



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* Fuel consumption figures of 7.9/100km down from combined urban and extra urban cycles. Amarok Single Cab available in 2.0 TDI 120kW Trendline, 2.0 TDI 120kW 4Motion Trendline, 2.0 TDI 160kW 4Motion Trendline, 2.0 TDI 160kW Basic 4Motion, 2.0 TDI 160kW Trendline and 2.0 TDI 160kW Basic. The fuel consumption values are determined using the prescribed methods of measurement (EC Regulation 60/155/EEC).

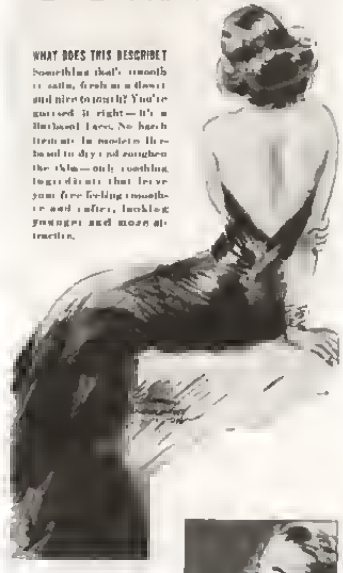


Every "Up-to-Date" Boy Plays the Harmonica

1928 Being young wasn't easy in the late 1920s, especially if you couldn't play the harmonica. As this ad from Hohner Harmonicas pointed out, you had no chance of being "up to date" if you couldn't wrap your lips around one of their instruments and harmonise with popular songs as well as old-time melodies.

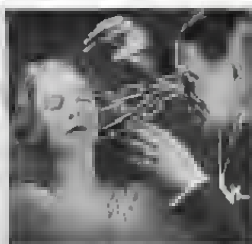
OOMPH!

WHAT DOES THIS DESCRIBE?
Something that's smooth
as satin, fresh as a flower
and nice to touch? You're
guessed it right—it's a
Barbasol face. No harsh
irritants. In modern life,
hard to dry, not roughen
the skin—only soothing
ingredients that leave
you free feeling smooth
and soft, looking
fresh and more at
ease.



< **1940** Who said ads from the 1940s weren't edgy? The accompanying text, using phrases such as "smooth as satin" and "nice to the touch", actually referred to a man's chin after he used Barbasol shaving cream.

> **1930** In just a few hours, promised this advertiser, you could learn to bend people to your will. Not only that, but the "hidden secrets of hypnotism" would enable you to become master of your self, friends and acquaintances—of either sex! You'd learn about the nine stages of hypnotism, mental telepathy, the hypnotic mirror, magnetic healing, and presumably how to shoot lightning bolts from your eyes.



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1955 One of PM's more unusual covers showcases an article on DIY Christmas mobiles for the garden, including one that simulated a dash between Santa's reindeer-drawn sleigh and "modern traffic" (slings, bandages, broken antlers et al). Interestingly, the same issue carries a story on outwitting "electronic snoopers", a harbinger of this month's cover story, "Digital spies".

TOUGH ON SWEAT. NOT ON SKIN.

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ALTERNATE ENERGY

Depth chargers

WINDFLOAT PROTOTYPE

Developer: Principle Power, Seattle
Height above water: 50 m
Depth below water: 13 m
Power produced: 2 megawatts

SWAY PROTOTYPE

Developer: Sway AS, Norway
Height above water: 13 m
Depth below water: 15.8 m
Power produced: 7.2 kilowatts

The airstream 30 km offshore blows at an average 10 m per second, a prime condition for wind turbines. But it's prohibitively expensive to build a turbine in deep water, and the ocean floor that far off most of the coastal United States is a long way down. Two companies are testing floating turbine prototypes in Europe that are designed to operate at great depths, and at low cost. Officials with the US Department of Energy are evaluating both real-world tests for domestic use.

STEPHANIE WARREN

STABILITY

WindFloat's base adjusts the water level in three columns to keep the turbine level. Engineers designed Sway's tall, slender tower so that its centre of gravity lies below the structure's centre of buoyancy, allowing it to remain steady even when seas are turbulent.

AFFORDABILITY

WindFloat saves steel by placing its tower on a column instead of on a platform. The Sway design economises and gains structural support with steel cables. Its blades are mounted downwind – the opposite of most turbines – to keep them clear of the cables.

ROTATION

WindFloat's 91-ton nacelle, or gear housing, turns to meet the breeze, like a typical land-based turbine. The Sway's entire tower rotates on a universal joint that connects the turbine to the tension-leg anchor; the blade clearance from the wires remains constant.

Diagrams by RAG

► Watch a BMW laser headlamp demonstration at www.popularmechanics.co.za

ROAD SCIENCE



Shine on → LEDs quickly became the luxury-car headlight of choice after Audi adopted them in 2007. Now BMW is one-upping the competition with *headlamps that use lasers 1 000 times as intense and twice as efficient as LEDs*. To be safe for human eyes, the blue beams are converted into white light by yellow phosphor. BMW equipped its 2011 i8 concept car with the laser lights and will probably use them in selected models over the next few years. – ANDREW DEL COLLE

ECONOMIC INFRASTRUCTURE

Turning milliseconds into millions

HIGH-SPEED FINANCIAL TRADING GETS EVEN FASTER WITH A NEW TRANSATLANTIC CABLE.

BY JOE PAPPALARDO

The newest fibre-optic cable crossing the Atlantic won't carry voice or Internet data. Instead, the line from New York to London will beam financial information to money marketers and hedge-fund traders – 5 milliseconds faster than rival lines.

"If you are trading in one market, you want to be monitoring what's happening in the other markets," says Bjørn Thorvardarson, CEO of Hibernia Atlantic, the firm installing the cable. "And if you know that 5 milliseconds faster or sooner than somebody else, you have a big leg up."

In this day of automated, high-frequency trading, algorithms automatically execute sales and purchases based on triggers in financial data. Regardless of a trader's investment strategy, his or her software often reacts to the same economic data. And as always in the world of trading, the first orders on the books are the first ones executed. With a split-second advantage, a

trader's order can jump to the head of the line, before prices change as more algorithms place similar orders.

Congress and market regulators are becoming leery of automated trading. "The SEC doesn't have the technology to understand if high-frequency trading is legitimate or if it's manipulative," says Larry Tabb, CEO of the TABB Group capital market research firm.

Thorvardarson says his customers aren't worried. "To be better than the competition – that's what competition is about," he says. The route survey should be finished early in 2012; the R2,4 billion cable will be ready for service in 2013.



The survey ship at left is currently scouting every centimetre of the planned route by pulling along a sonar scanner 9 m above the ocean floor. The instrument details the make-up of the bottom, which ranges from sharp rocks to soft clay; this determines the toughness of cable to be laid in a given stretch. In shallow water – anything less than 1 000 m deep – the cable must lie at a depth of at least 3 m to protect it from commercial fishing trawls.

Did this notch cause a tragedy? Photos taken just before the accident show that an elevator trim tab is missing from the aircraft. At high speeds, the trim tab can vibrate violently and break; without it, the aircraft could lose control.



WHAT WENT WRONG:

Reno Air Race crash

AFTER A MID-AIR MALFUNCTION LED TO MULTIPLE FATALITIES, PM EXPLORES WHETHER SAFETY CHANGES CAN SAVE AIR RACING.

BY JEFF WISE

Movie stunt pilot Jimmy Leeward, the 74-year-old who flew *The Galloping Ghost*, was a favourite at the venerable air races at Reno.

The crowd gasps as the wayward air-race plane banks ominously toward the viewing stands. Moments later, the 6-ton World War II P-51D fighter plummets to the ground, killing 10 spectators and pilot Jimmy Leeward, and injuring 74. The crash on 16 September last year at the National Championship Air Races in Reno, Nevada, threw the future of the 47-year-old competition into question.

Leeward's heavily modified P-51, *The Galloping Ghost*, failed while travelling at about 800 km/h – far faster than it was originally designed to go. The aircraft's nose suddenly pitched upward, the motion causing a spike in G-forces. This could have been enough to cause Leeward to black out; he is not visible in the cockpit in the video of the incident. The aircraft then rolled and plunged towards

the ground at full power.

Photos and video of the tragedy also indicate a possible cause: part of the tail called an elevator trim tab, which helps stabilise the aircraft, is missing. If that part broke off, it could have caused the plane to lurch into a vertical climb.

No matter the cause, the air races at Reno are now facing scrutiny. "It doesn't take a rocket scientist to see that, with the planes so close, there's a possibility of danger," says Andy Chiavetta, a mechanic on one of the planes competing that day. "In the pits, we all know that there's risk, and so do 95 per cent of the people in the stands. It's a part of racing."

NEXT: HOW AIR RACING CAN BE SAFER →

Photos: (left) by AP/Wide World Photos (aircraft)

Saving Reno

AIR RACES THRIVE ON VIEWERS WATCHING AIRCRAFT FLYING NEARBY AT HUNDREDS OF KILOMETRES PER HOUR. FINDING THE BALANCE BETWEEN ENTERTAINMENT AND RISK WILL BE VITAL TO CONTINUING THE AIR RACES AT RENO.

Are FAA standards sufficient?

The FAA mandates that spectators watching high-speed manoeuvres be set back from the race line by at least 450 m. That distance is based on scatter diagrams that calculate where debris would land if pieces came off a plane on the course. But no FAA precaution takes into account what occurred at Reno, an aircraft leaving the course intact and flying into the crowd, nearly 600 m away.



After the US National Transportation Safety Board issues its report on *The Galloping Ghost* crash later this year, the FAA may change its air-race requirements. But every possible fix has a drawback – after all, fans come to watch aircraft roar past at close range.

Move the viewing stands to inside the course.

Pro: Debris shed from damaged planes would tend to fly away from the crowd, not into it.

Con: Pilots in planes with mechanical problems would have to fly over the crowd to reach the runway.

Lengthen the straightaway.

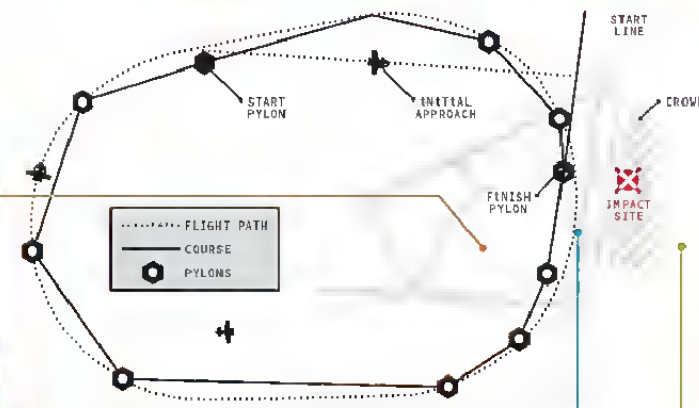
Pro: Would move spectators farther from the zones near turns, the area with the greatest lethal potential.

Con: There's not much room at Reno; the course is constrained by mountains and residential development.

Move the viewing stands back from the course.

Pro: This is the most likely solution, as this distance is the key parameter that the FAA sets for air-race and air-show spectator safety.

Con: Putting more distance between fans and the action risks diluting the excitement.



Between the start of the Reno air races in 1964 and 2010, 19 people lost their lives. Last year's crash was the first that hurt or killed spectators. Here are some notable fatalities:

1972 HE Thomas crashes a home-built biplane; the NTSB never determines the cause.

1975 Pilot MD Washburn dies after his wing clips a pylon and he crashes. About 15 minutes later, wing walker Gordon McCollum is killed when his head hits the ground during a stunt.

1994 Bill Speer, flying a P-51D, crashes while pulling off the racecourse after his windscreen is obscured by oil leaking from the propeller. Six days later, another pilot dies after a collision at the start of a race.

1999 The tail of a P-51R disintegrates while in flight, killing pilot Gary Levitz and damaging a house. No one on the ground is injured.

2002 Tommy Rose crashes his home-built airplane into the ground at over 600 km/h. The NTSB states that the aircraft's horizontal stabilisers failed due to excessive speed.



• INTERPLANETARY GEOLOGY

Sweater weather on Mars

A four billion-year-old rock from Mars, probably blasted into space by a meteor, holds the first measurable evidence that the Red Planet once had liquid water. Studying the bonds between rare isotopes of carbon and oxygen found in the rock, scientists at the California Institute of Technology in Pasadena determined that the elements had combined at about 18 degrees Celsius in an environment with liquid water. — ALEX HUTCHINSON



This rock has a story to tell. Heavy isotopes of carbon and oxygen bonded together in the presence of water, and at a moderate temperature.



• QUICK HITS



I'VE SEEN A DOUBLE RAINBOW. COULD I EVER SEE A TRIPLE?

Double rainbows are fairly common: a second arc is produced by light reflecting twice between the inner walls of raindrops before exiting. Scientists have long assumed that a third arc would be too faint to see. But new calculations by Naval Academy meteorology professor Raymond Lee suggest that a triple rainbow could be visible under certain conditions — about 40 degrees from the Sun when it's peeking through dark clouds. Armed with this information, rainbow chasers in Germany snapped the first-ever photographs showing a triple rainbow.



JUST SAY NO — TO CANCER

CAN A CLUB DRUG ROLL OVER A DEADLY DISEASE?

BY AMIR KHAN

Researchers from the University of Birmingham in England have found a new weapon to fight cancer — Ecstasy. "We found that blood cancer cells make the same proteins that are targeted by Ecstasy in the brain," says John Gordon, a professor of cellular immunology. "We reasoned that if they have these proteins on them, then Ecstasy might affect them in some way. We found that at very high doses, the drug was able to kill some of them."

Gordon used a modified form of Ecstasy that is stronger but less toxic than the club drug. "The new form of Ecstasy gets inside the blood cancer cells more easily," he says. He adds that even though the psychoactive effects of the drug are reduced, he still isn't sure of the long-term side-effects. "We now need to go through testing to see whether the new drugs work in the body as well as they do in the test tube," he says.



Silver shipwrecks

Treasure hunters have located two wrecks in international waters off the coast of Ireland — and more than R1,6 billion in silver they are believed to have been carrying. Tampa, Florida-based Odyssey Marine Exploration pinpointed the vessels using an MAK-1M sonar scanner towed several kilometres below the surface; remotely operated subs were later deployed to confirm the wrecks' identities. The SS *Gairsoppa*, a 125 m-long British cargo ship torpedoed by the Germans in 1941, held the majority of the loot, an estimated 7 million ounces of silver. The 450-foot SS *Mantola*, sunk in 1917, is believed to have contained another 198 000 kg of silver. Robotic salvage missions will begin in mid-2012; the company and the British government will share the profits 80/20, respectively. — AH

Illustration by Richard Perez, icons by Janer Kasei

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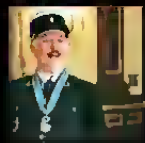
hp.co.za/workstations

Everybody On 

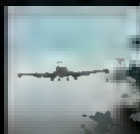
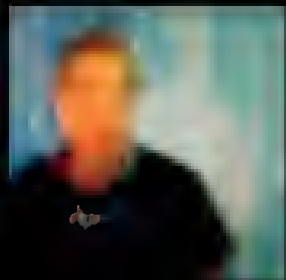
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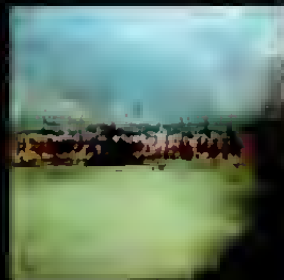
21ST-CENTURY MEDICINE



The eye sees:
A scene from a Steve Martin movie.
Reconstructed image:
Researchers record brain activity and match it with a video database, producing a human form with something around his neck.

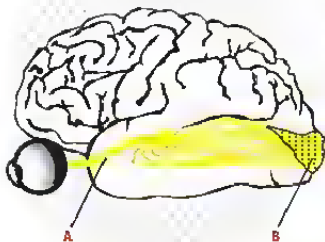


The eye sees:
An aircraft in flight, and foliage in the foreground.
Reconstructed image:
A match of brain activity and database videos shows a horizontal shape, a blue backdrop, and darkening on the right.



Video on the brain

TAKING STRIDES TOWARD UNDERSTANDING HOW THE BRAIN PROCESSES STIMULI TO RECOGNISE IMAGES, RESEARCHERS FIGURE OUT HOW TO PROJECT NEURAL ACTIVITY ON TO A TV SCREEN. BY STEVE ROUSSEAU



Images are transmitted to the brain via each eye's optic nerve.

A These signals are first processed in the primary visual cortex.
B Scientists examine the primary visual cortex to produce images from brain activity.

HOW DO THEY DO IT?

UC Berkeley professor Jack Gallant and his team use MRI to track blood-flow changes in a subject's primary visual cortex – the brain's largest visual processing centre – as he or she watches a movie. The researchers then create a model of the visual cortex that matches the blood-flow pattern with the images the subject is viewing.

Algorithms are applied to compare the brain signals with a catalogue of about 5 000 hours of YouTube video. The images that most accurately correspond to the brain activity are compiled into a composite video that resembles the YouTube footage.

"I think it's very impressive that they can get these admittedly crude re-creations of our internal representations of video," says Marcel Just, director of the Carnegie Mellon University Centre for Cognitive Brain Imaging, who was not involved in the study.

WHAT'S IT GOOD FOR?

Such brain-visual linkages could one day aid communication with stroke or coma patients. Gallant says that once his team's technique has been refined, it could also record and play back dreams. The obstacle to this is understanding how the brain's visual processing changes when a person is sleeping or awake. Gallant is confident this will happen, commenting: "It's only a matter of time."



LASER BOMB DETECTION The best place to be when searching for concealed bombs is as far away as possible. A system developed by Michigan State University chemists, with support from the US Department of Homeland Security, uses a femtosecond laser that vibrates molecules with ultra-short pulses and identifies them with longer ones. The laser is no more powerful than a presentation pointer, but new studies show that the system could detect multiple chemical signatures in real-world surroundings.



TWO SUNS ARE BETTER THAN ONE Astronomers call it a circumbinary planet; *Star Wars* fans are calling it Tatooine, after the Skywalkers' home planet. SETI Institute researchers, using data from Nasa's Kepler space telescope, found a planet about 200 light-years from Earth that is orbiting two stars – the first of its kind confirmed. Periodic dips in the stars' brightness allowed astronomers to calculate that a planet about the size of Saturn completes an orbit of the two-star system every 229 days. **PM**



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THE SECRET WAR

BY ADAM PIORE



Foreign spies hack computers to bleed billions from industry and steal military secrets. PM explores the dark, relentless scourge of digital espionage.

THE FIRST WARNING THAT HACKERS HAD PENETRATED THE AMERICAN OIL COMPANY came soon after the initial breach, in mid-2009. The computer help desk received complaints from employees who were locked out of their accounts or whose computers had already been accessed.

Then the complaints abruptly ceased: the digital spies had obtained an administrator password and were intercepting help-desk tickets, unlocking accounts, and notifying users that their problems had been fixed. With that access, the hackers copied thousands of confidential

PHOTOGRAPH BY JAMES WORRELL
MODELS BY MEGAN CAPONETTO

e-mails – including those of top executives – and transmitted them to China in massive files late at night, after the oil company's employees had left for the day.

By the time the FBI informed the company of suspicious network traffic a year later, Chinese firms had outbid the oil company on several high-stakes acquisitions by just a few thousand dollars. But it could have been far worse: for months, malware that allowed the hackers to fake over terminals had been burrowing deeper into the company's systems and had wormed its way into computers that controlled oil-drilling and pipeline operations.

"People were alarmed that their e-mail was compromised, but the hackers could have crippled the business," says Jonathan Pollet, the founder of Red Tiger Security in Houston. In early 2011, Pollet helped the oil company identify some of the hackers' breaches; he refused to name the company, citing a confidentiality agreement.

The example Pollet cites is just one incident in an ongoing, aggressive campaign of electronic espionage that costs firms billions, endangers military secrets, and threatens to erode the West's technological edge, as computer hackers – often but not exclusively traced to China – help their clients, and their countries, gain the upper hand in business deals and steal intellectual property. (An October 2011 report prepared for the US Director of National Intelligence titled "Foreign Spies Stealing US Economic Secrets in Cyberspace" explicitly accuses China and Russia of hacking US companies, calling Chinese hackers "the world's most active and persistent perpetrators of economic espionage".)

The phenomenon blurs the lines between white-collar crime, international spying, and even acts of war, but the attacks are known in the intelligence community as advanced persistent threats, or APTs. Well-financed, patient teams of hackers that US intelligence agencies believe are backed by foreign governments now constitute a major national security risk. The hackers use tactics that are inherently difficult to trace and choose targets that have deep roots within US infrastructure, government and military. Recent news accounts have identified APT victims that include Google, ExxonMobil, Royal Dutch Shell, Morgan Stanley, Dow Chemical, Symantec, Northrop Grumman, and Lockheed Martin, to name just a few.

Private industry is understandably reluctant to reveal such breaches, even to governments: if a digital attack strikes fear in the hearts of a company's executives, one can only imagine how it would make shareholders feel. But digital spying is like a cockroach infestation – for every one that you see, thousands thrive out of view. "I can't find an organisation, an entity, a business, or a department that hasn't suffered from cyber intrusions," says Gordon M Snow, assistant director of the FBI's Cyber Division. "If they



German chancellor Angela Merkel (above) confronted China's premier, Wen Jiabao, during a 2007 state visit to Beijing after the magazine *Der Spiegel* reported that computers in the German chancellery had been infiltrated by Chinese malware. German officials traced the attack back to Trojan programs hidden inside Microsoft Word and PowerPoint files. The officials discovered the software trying to offload 160 gigabytes of data from government computers and send it to a botnet of hijacked computers in South Korea. The Germans believed the botnet was controlled by the People's Liberation Army.

really believe they haven't, they're just not aware of it yet."

In August 2011, a report by the security firm McAfee detailed hacks into some 72 public and private computer networks in 14 countries and warned of "the biggest transfer of wealth in terms of intellectual property in history".

Technology theft is the most common motive for digital espionage, but China and other nations have used it to squelch internal political dissent as well. Stolen source code from Google was used to hack into the accounts of Chinese dissidents, and after an Iranian hacker broke into Dutch security firm DigiNotar, the stolen technology was used to help his government spy on troublemakers in Iran. These attacks can cause collateral damage that compromises the security of everyone online. Digital security certificates from DigiNotar were part of the basic verification system of the Internet. If you can fake one of those, you can fool a browser into thinking any site is safe.

HACKED HEADS OF STATE

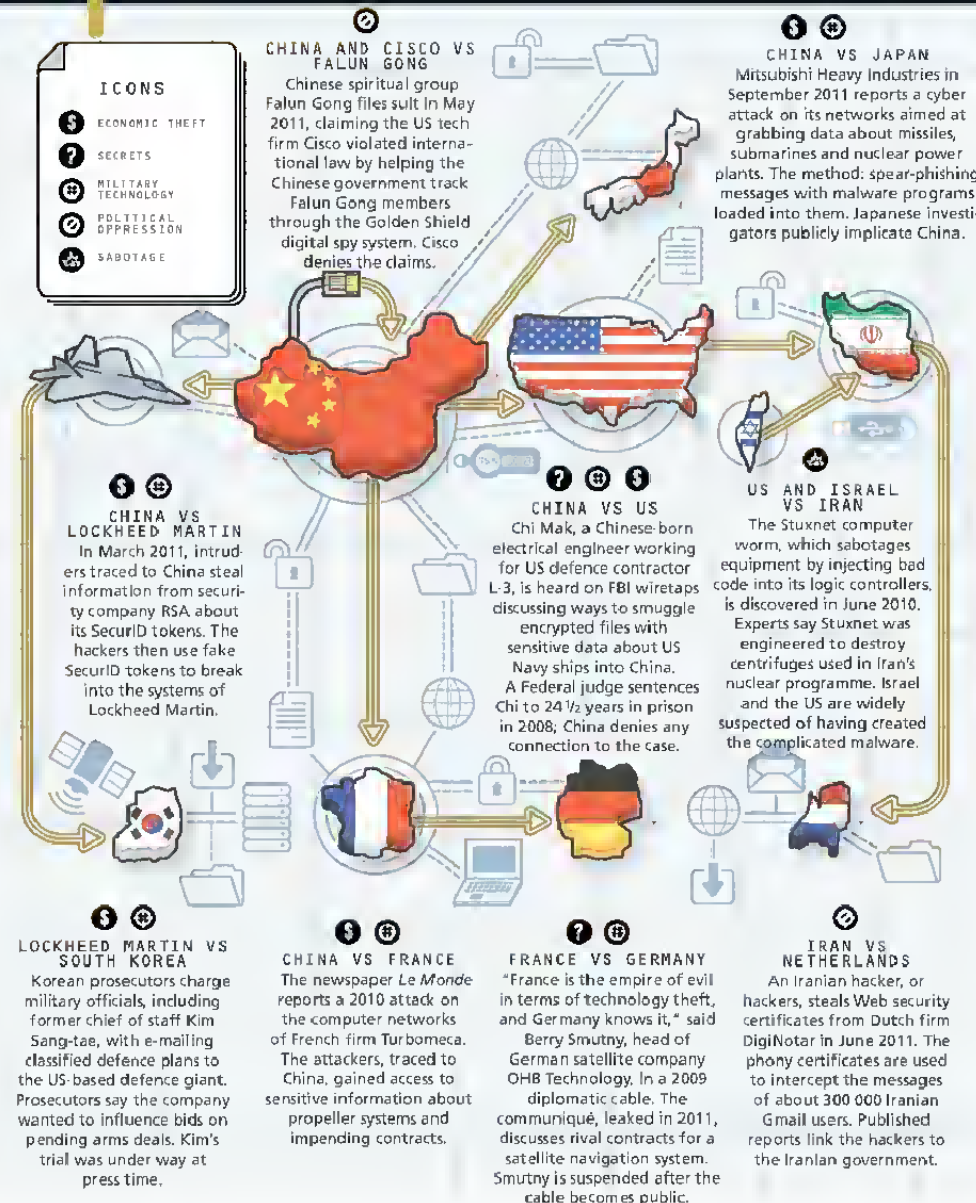
A history of hacks

The United States itself is no slouch at cyber spying. The country's National Security Agency and the Pentagon possess the most sophisticated signals intelligence and digital warfare technology in the world. That gives them the ability to spy on foreign cellphone calls, shut down enemy air defences, or even remotely cause equipment in an adversary's weapons facility to self-destruct.

But former US officials insist the government does not engage in economic espionage or intellectual property theft from foreign companies. In part, they contend, that's because there is little IP they would want to steal, and to do so would undercut efforts

WHO'S SPYING ON WHOM?

High-tech espionage is a game with no rules. In this secretive world, rival countries and multinational companies use invasive software, moles and talented hackers to stab each other in the back. – Joe Pappalardo



Picture by Getty Images

to discourage such theft by other nations. Private companies, meanwhile, would be breaking the country's law if they hacked into the servers of state-owned competitors in places such as China and Russia – although some US multinationals have been accused of dirty business overseas (see "Who's Spying on Whom?"). "(We have) an enormous stake in the integrity of the intellectual property regime," says Joel Brenner, former head of US counter-intelligence during the Bush and Obama administrations and the author of *America the Vulnerable*, a book on digital espionage published last September. "Many of our adversaries don't believe we don't do this. But it's really true. We don't." According to James Lewis, a digital security expert at the Washington, DC-based Centre for Strategic and International Studies, this apparent unwillingness to retaliate presents "an asymmetric disadvantage" that rivals are exploiting to win an emerging digital cold war.

Computer espionage has a history almost as long as that of the modern Internet. In the late 1980s, the German hacker Markus Hess and several associates were recruited by the KGB to penetrate computers at American universities and military labs. They made off with sensitive semiconductor, satellite, space, and aircraft technologies. Today, China, Israel and Russia are reportedly the most aggressive about stealing secrets. But China is playing a game of a different magnitude. "The Chinese didn't create this problem," Brenner says. "But there's no question China is the worst offender now. They are all over us. It's just relentless."

Experts believe today's attacks on US industry are an extension of a series of attacks on American military computer networks that took place in the late '90s and early 2000s. The assault has netted the Chinese sensitive military technologies that might one day be used against us. Then, as now, the Chinese government has vehemently denied that it has any state-sponsored hacking programme, calling such allegations groundless and irresponsible.

Plausible deniability is precisely what makes digital espionage such an effective tool. It's difficult to detect and impossible to prove – and thus can't be used to justify retaliation. Digital security experts call this the attribution problem. "At most, you know the immediate computer involved in attacking you or receiving the stolen data – and sometimes you don't even know that," says Columbia University computer scientist Steven Bellovin, who advises the Department of Homeland Security on the issue. "But you don't know who actually controls the computer. It could be another hacked computer somewhere that somebody else is controlling from somewhere else."

Still, few buy the Chinese denials. There have simply been too many attacks traced to the mainland. Secret US State Department cables obtained by WikiLeaks and made public by Reuters detailed a widespread digital spying operation, Byzantine Hades, linked to the People's Liberation Army Chengdu Military Region First Technical Reconnaissance Bureau, an electronic espionage unit of the Chinese military. According to the cables, Byzantine Hades targeted not only the US government and industry, but also high-level European officials. The Chinese hackers even managed to remotely activate the computer microphones and Web cameras of French officials so they could peep in on everything from office gossip to high-level diplomatic planning sessions. In the past, surveillance like that would have required

spies to know where their targets were staying and Mike the room – but in the age of cellphones and laptops, spies can listen in on foreign officials half a world away.

Anatomy of an attack

In February 2011, McAfee released a report detailing a series of hacks called *Night Dragon*. Emanating from locations in China and aimed at six global oil, gas and petrochemical companies, the hacks resembled the oil company attack described by Pollet. The media later identified the victims as ExxonMobil, Royal Dutch Shell, BP, Marathon Oil, ConocoPhillips, and Baker Hughes, all of which declined to discuss the report when asked by *POPULAR MECHANICS*.

Regardless, the methods described by both Pollet and McAfee are straight out of the playbook of Chinese-based APTs. Instead of trying to identify vulnerabilities in a company's firewall, APTs focus on exploiting the one thing that's impossible to control – the vulnerabilities of company employees.

The hackers Pollet investigated found personal information about the oil company's executives on social-networking sites such as Facebook and Myspace. Then they crafted e-mails aimed at enticing the executives to click on a poisoned link.

"The initial attack is very subtle," Pollet says. "It no longer says, 'I am a Nigerian prince and need to hide a bank account.' If the hacker can find an executive who likes to restore old cars and can find the names of some of his friends, he will send an e-mail saying 'Hey, I was talking to our friend Paul, and he said you were restoring 1950s Chevys. I found this great Web site you should check out.'"

When the victim clicks on the link, it takes him to a Web page where malware loads on his computer. It sits there for days until it wakes

up and phones home.

The malware might post a code to a Twitter account or post a comment as simple as "I'm going skiing on Saturday" to a blog. That beacon alerts hackers that their malware has taken root and is ready for instructions. The hackers can then



VIDEO

> Visit www.popularmechanics.co.za to learn more about South Africa's first school for computer forensics (search keyword: cyber sleuths), where they tackle anything from hacking to hard-drive reconstruction.

respond with coded directives by the same means.

It wasn't until a year into the hack on the oil company that the FBI contacted executives and informed them they had spotted data traffic leaving their network and heading to servers in China known to be used to command and control networks, Pollet says. The FBI's Snow says he cannot comment on specific cases. But it was certainly not the first time the FBI stepped in. The current campaign of cyber espionage is so widespread, he says, that it has forced a "significant cultural shift" in the way the FBI handles cyber intrusions. Previously, "the No 1 priority was to protect the operational security of the investigation and the prosecutive equities on the criminal side". Although those goals are still important, "it's even more important that the victims understand they have been victimised", he says.

Emergency response

After the FBI alert, the oil company brought in security firms Red Tiger and Mandiant to expunge the intruders. But expelling an APT isn't as simple as it sounds. "They are agile, dynamic, and, if you defeat them once, they're going to change their tactic," says Richard Bejtlich, chief security officer for Mandiant, who also would not comment on the specifics of the oil company attack. The attackers, he notes, are usually in it for the long haul and are likely to return if the company still has intelligence on its networks that the hackers or their employers consider of value.

The best approach once an intrusion is detected is not to tip your hand until you are ready to respond with a serious defence. Countermeasures usually involve first identifying as many infected computers as possible by looking for suspicious software on hard drives and tracking which computers have been contacting suspicious

Last year, the Chinese military unveiled the Chengdu J-20 stealth fighter. Some intelligence experts see the J-20 as the result of a long campaign of technology theft. The Chinese are believed to have inspected and reverse-engineered aspects of an American F-117 Nighthawk downed in Serbia in 1999. Also, in the early 2000s, Chinese spies are suspected of hacking into a US military research facility in China Lake, California, and making off with computer files relating to stealth technology.



STOLEN
STEALTH
TECH

host servers. The response team then attempts to pull as many infected computers as possible off the server at once, "by any means necessary", Bejtlich says. "In some cases, it's literally pulling a cable out of the computer."

But often it's impossible to know whether all the malware has been successfully removed. And even if it has, the attacker will often attempt to break in once again, using more sophisticated, perhaps never-before-seen code. That's one of the reasons that many in the intelligence community are calling for a new security paradigm, one that places an emphasis on information sharing and preventive measures.

A government can go only so far to protect the networks of private companies. In the past year, the US Department of Defence launched a pilot programme with the defence industrial base that helps contractors improve security and share information about emerging forms of malware. Most companies, however, remain shockingly vulnerable to massive security breaches and naive about the extent of the problem.

Even with co-operation, most security experts believe that keeping a capable and determined adversary out of a system is impossible. "Perimeter defence is finished," Brenner says. "If you want to talk about really confidential stuff in e-mail, you've got to understand that, if you've got a real sophisticated adversary, they're reading it."

The FBI's Snow agrees. "We have to have a cultural shift in the nation where we understand that there is no secure system, that people are going to be hacked," he says.

As for retaliation, Bejtlich says he often gets questions from high-level executives who want to "hack back", even if all that means is retaliating against a Chinese computer with a virus that will disable it.

"There is sufficient resistance from outside counsel because it would violate US law, and in government agencies, there is no support to do that," Bejtlich says.

When asked if compromised companies might use the knowledge that they have been infiltrated to feed spies false data, Bejtlich scoffed. "Those deception manoeuvres are so far beyond the capability of any private corporation that no one could pull that off," he says. "You couldn't protect the planning. The bad guys will see it all and laugh."

PM

GREAT STUFF

COMPILED BY SEAN WOODS seanw@ramsaymedia.co.za

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Adventurers looking for a convenient way to power their mobile gadgetry should consider Suntica's SolarStrap portable solar-powered chargers. Two models are available – the basic SS-W100 (with three tips: Nokia 2, 1 mm, Motorola mini-USB, and micro-USB) and the SS-W204 (made specifically for iPods and iPhones). Both feature splash-proof and virtually indestructible flexible solar panels and lithium-polymer battery packs with intelligent charge control electronics.

The 85 g SS-W100 provides over one hour of talk time (or 50 hours of standby time) from a one-hour solar charge. The SS-W204 comes in a range of funky colours, provides 16 minutes of talk time, and weighs 65 g. The batteries in both models can also be charged via a USB port, a vehicle's 12 V auxiliary socket or a wall charger. Expect to pay about R400 for the SS-W100 and R800 for the SS-W204. Contact distributors DCS on 011-466 5099 or visit www.dcs.co.za.



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HERE'S THE NEWEST GEAR YOU'LL WANT TO OWN



GAMING TO GO

Sony's latest portable gaming gadget, the PlayStation Vita, is sure to delight fans and haul in droves of new devotees to their virtual fold. Incorporating a 12,7 cm OLED touchscreen display and a multi-touch rear pad, it allows users to interact directly with games in 3D-like motion and "touch, grab, trace, push and pull" finger action. It also features two analogue sticks that enable a wider range of game genres to be brought into the portable experience.

Featuring Wi-Fi and 3G network connectivity, together with a number of applications, it gives you the opportunity to play with friends anywhere in the world. For example, one pre-installed app, called "Near", lets you share gaming information and other location-based gaming features. The "Party" app (also pre-installed) allows you to enjoy voice or text chat not only during online gaming, but also while playing games or using different applications. Social networking and communication services such as Facebook, Skype and Twitter are available. Price: about R3 500. Visit <http://playstation.com/psvita>.

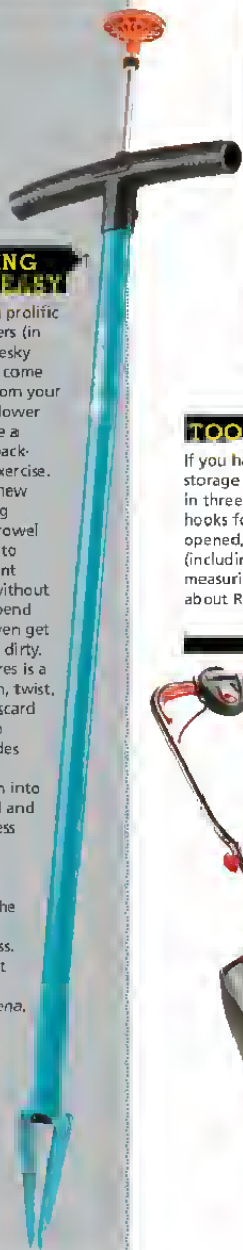
WIRED FOR SOUND

In search of a decent sound system to complement your fancy flat-screen TV? LG's ARX9000 AV Receiver system could be what you need. The glossy black design looks good, but as far as audiophiles are concerned, it's what's under its skin that matters – and the LG delivers the goods. For starters, you get a whopping 1 580 W output and 7,2-channel multi-directional surround sound. Next up: a specialised horn compression tweeter, and a Dual Duct system that helps release air more efficiently from inside the enclosures to produce a powerful bass. Price: about R8 500 (with HDMI DVD player) or about R9 000 (with Blu-ray player). Contact LG on 011-323 8000 or visit www.lg.com/za.



WEEDING MADE EASY

Eradicating prolific land invaders (in this case, pesky dandelions) come to mind) from your lawn and flower beds can be a tiresome, back-breaking exercise. Gardena's new 110 cm-long Weeding Trowel allows you to commit plant genocide without having to bend down or even get your hands dirty. All it requires is a simple push, twist, pull and discard action. Two special blades allow easy penetration into the ground and the effortless removal of weeds, the ejector disposing of the debris with minimal fuss. Price: about R280. Visit www.gardena.co.za

**TOOL ORGANISER**

If you have a small garage or work area and are looking for a convenient and secure storage system, you might be interested in ATM's range of lockable wall units. Available in three sizes, they are made from durable powder-coated steel. Each unit comes with hooks for your tools, and wall plugs are included so you can attach it to a wall. When opened, they lie flat against the wall. The smallest unit, measuring 600 x 600 x 200 mm (including 25 single and 5 double hooks) costs about R2 000, and the largest option, measuring 800 x 800 x 300 (including 30 single and 10 double hooks) will set you back about R3 000. Contact ATM on 011-787 6070 or visit www.atmsa.info

**SMOOTH OPERATOR**

Mowing your lawn doesn't need to be a chore. Flymo's wheeled EasiMo 1 000, weighing in at just 9,5 kg, is easy to lift and manoeuvre around obstacles or use in small spaces, making it a good fit with small-to medium-sized gardens. With a 37 cm cutting width and three cutting heights, its 900 W motor can take the rough with the smooth. It has a 29-litre hopper and a rear roller that creates neat lawn stripes. Price: about R1 000. Visit www.flymo.co.za



Editor's choice

**SMASH 'N GRAB?**

It's bad enough being involved in a motor accident, but when you have to dispute the "facts" proffered by the offending party, the situation goes from bad to worse. Enter RoadHawk's DC-1 vehicle black box camera system, a thoroughly useful device that takes the pain out of insurance negotiations by recording the impact in real time, along with all sorts of useful information.

Its 120-degree WDR (wide dynamic range) camera allows high-quality images to be captured (especially in adverse weather conditions) in relatively small file sizes. Because it records in standard MP4 format, the footage can be played back on virtually any computer without requiring extra software.

It locks on to as many as nine satellites to attain accurate GPS co-ordinates and measure speed and direction. The footage is recorded in 1-minute loops, allowing up to 48 hours of data to be stored when using a 32 GB SD card. When the card is full, it automatically overwrites the oldest files. Playing back the video with the included PC software, you'll see the vehicle's progress overlaid on Google Maps as well as a constant display of its speed, direction, acceleration/deceleration, and G-force data. Price: about R2 500. Contact RoadHawk on 011-467 8666 or visit www.roadhawk.co.za

DIGITAL CONTENT ON YOUR Telly

With the thousands of Internet TV and radio stations available nowadays, not to mention all the digital content dogging home computers and portable hard drives, why settle for conventional television programming? Asus' O!Play Mini Plus allows you to watch what you want, when you want, from the comfort of your couch. In fact, this smart TV set-top box is so versatile that you can play content from a connected PC, smartphone or tablet, and even play files straight from a connected USB drive or memory card. Other features include Gigabit Ethernet LAN support for lag-free streaming of HD multimedia content, and 802.11n wireless connectivity. Price: about R700. Contact Asus South Africa on 011-783 5450 or visit www.asus.com

**SOCIAL CONNECTOR**

Looking for a capable and above all, affordable mobile? You'd be hard pressed to do better than LG's Optimus Pro C660. Employing the Android Gingerbread mobile operating system, it offers enhanced multimedia and gaming support and enhanced power management. It also comes with a portrait bar QWERTY keyboard and a 7 cm TFT capacitive touchscreen for quick navigation. Dedicated keys for e-mail and scheduler boost the convenience factor even further.

Internal storage can be increased up to 32 GB via microSD card (2 GB included). Connectivity options include Wi-Fi 802.11 b/g/n, Bluetooth v3.0 and a micro-USB port. Besides that, there's a 3.15 MP camera, VGA video capture, and GPS with A-GPS support. Price: about R1 800. Contact LG on 0800 545 454 or visit www.lge.com/za



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This carry-over feature applies to all MTN Internet packages and allows you to carry over unused Internet data for additional months over the term of your contract, to a maximum of two times your monthly Inclusive Internet value.

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GREAT STUFF



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The ability (and desire) to use power tools is one of the things that distinguishes us from other hominids, but you can't always lug a dirty great toolbox around with you. That's where Leatherman's Wingman comes in. This pocket-sized stainless steel wonder is your go-to tool for a variety of projects around the house, on the job, or at the campsite. It's equipped with all of 14 tools, including a one hand-opening blade and spring-action plier jaws and a bottle-opener (you know, for when the work's done). Price: about R400. Contact Awesome Tools on 021-981 6672 or visit www.awesometools.co.za.



3D IN YOUR POCKET

There's been a lot of hoo-ha about 3D images and video content of late, but to date not much of this has translated into anything really practical. However, HTC's latest smartphone, the EVO 3D, might just change all that. Featuring two 5-megapixel cameras and an 11 cm stereoscopic qHD (quarter full HD resolution) screen, it not only allows you to capture 3D photos and video on the fly, but also lets you view content without having to wear those annoying glasses.

The handset is driven by a powerful, 1.2 GHz dual-core Qualcomm Snapdragon processor, delivering a fast browsing experience, instant image capture and smooth HD (720p) video playback. The camera performs well in low-light conditions, thanks to its wide, f/2.2 maximum aperture, and videos are recorded in 720p resolution at up to 30 frames per second. Oh, and you can switch effortlessly between 2D and 3D. Price: about R6 900. Visit www.htc.com.

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10 TECH CONCEPTS for 2012

> BY JOHN HERRMAN

HAPPENING NOW

Pascalisation



Louis Pasteur's name is synonymous with food preservation, but it's another long-dead French scientist, mathematician and philosopher whose research is changing the way we think about food: Blaise Pascal. Pascalisation, commonly known as high-pressure processing (HPP), is a method by which food is subjected to extreme water pressure – sometimes up to 5 500 bar – inside long, cylindrical metal chambers. This destroys living cells, including harmful bacteria such as E. coli and listeria, while leaving the texture and flavour of many foods surprisingly intact.

Sauces, fruit juices, guacamole, lunch meats and fish hold up well to pascalisation, and treated versions of these foods can be found in stores today. But falling equipment costs, demand for longer shelf lives, and a rash of bad PR for HPP's competition, food irradiation, will bring pascalisation into the mainstream, says VM Balasubramanian, a professor of food safety engineering at Ohio State University. "The food industry is conservative in terms of new tech," he says, "but in recent years, the industry has grown into a multibillion-dollar business." Some extreme applications for pascalisation include edible raw shellfish, and pre-cooked eggs and omelettes that can be stored at room temperature – for years.

A food-processing unit at Ohio State University subjects a fresh bell pepper to over 600 megapascals (6 000 bar) of pressure.

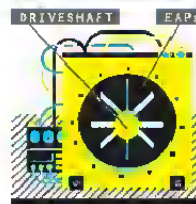
DRIVESHAFT

EAPs

Plastic muscles

Functional electroactive polymers (EAPs), known colloquially as plastic muscles, have been in development for decades, but their applications have been limited. (In 2005, the International Society for Optical Engineering held its first EAP versus human arm-wrestling match. Don't worry – the human won.) Recent research, however, has unlocked new potential for EAPs beyond sensors, actuators and fanciful experiments.

By placing large, flat spokes of EAP material between a floating hub and a fixed outer wheel, researchers at the Auckland Bioengineering Institute's Biomimetics Lab in New Zealand have been able to create a rotary motor that could directly compete with the ubiquitous magnet-based electric motors in many low-power applications. The technology has drawn interest from Nasa for its potentially high energy efficiency.



TRENDING

BIG IDEAS///
10 TECH CONCEPTS

HAPPENING NOW



Supertruck

What does it mean for a long-haul truck to be "super"? According to new standards set by the US Department of Energy, it means that it's 50 per cent more fuel-efficient than today's hardware – a goal that the agency, with the help of Volvo, Daimler, Cummins, Peterbilt and Navistar, hopes to hit by 2015. The new goals are specific to Class 8 trucks, which have loaded kerb weights of 15 tons or more.

More than R1,4 billion has been allocated by the DOE to engine and trailer manufacturers for a variety of projects, some reaching or nearing deployment. Near-term goals include wide-base low-rolling-resistance tyres, active tyre-pressure monitoring, hybrid drive trains, and new trailer shapes.

Daimler Trucks is working on dramatically reducing the size and weight of its diesel

Freightliner
Innovation Truck

engines, and Cummins is partnering with Peterbilt to produce a clean diesel engine with a waste-heat recovery mechanism. What will make these supertucks recog-

nisable on the road, though, is their exterior: aerodynamic trailers, cabins and wheel skirts provide an almost sci-fi appeal.

TRENDING

BEHIND THE SCENES

SUBCONSCIOUS MODE



Anyone who has woken up to a dead phone can attest that mobile devices suck energy whether you're using them or not. That's because, even when a device is inactive – say, in your pocket with the screen off – it remains alert for wireless data transmissions, in a state known as idle listening. University of Michigan researchers have developed a technology called Energy-Minimising Idle Listening, or subconscious mode, which dramatically lowers the rate at which a device's Wi-Fi card retrieves data packets.

By selectively listening only for small headers or tags, the device is able to anticipate incoming data and open up its full wireless connection capabilities accordingly. In testing, subconscious mode reduced energy consumption by 44 per cent in current mobile devices.

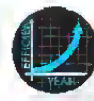
HAPPENING NOW

Mobile instant messaging

BlackBerry Messenger (BBM) paved the way for Internet-based mobile instant messaging. Apple, Google and Microsoft now have IM services of their own, sentencing over-priced texting plans to a well-deserved death.



Kooomey's law



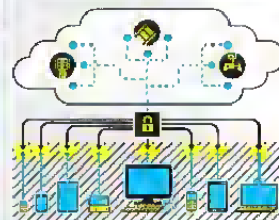
If one piece of computer science trivia can be said to have entered the collective consciousness, it's Moore's law. First formulated in 1965 by Intel co-founder Gordon Moore, it states that the number of transistors that can be placed on an integrated circuit will double every two years. In other words, processors become roughly twice as powerful every other year. Moore's law is still holding strong, but it has little to say about energy efficiency.

Kooomey's law is a proven computing law for the modern age, where wattage trumps all. Initially observed by Jonathan Kooomey of Stanford University, Kooomey's law states that the amount of computing power per joule – effectively per watt – doubles every one and a half years. This trend tells us about the future of computing's most exciting areas in a way that Moore's law can't, with equal relevance to battery-dependent smartphones and unfathomably powerful – and power-hungry – supercomputers.

Illustration by Lisa Fagan



VIDEO > Visit www.popularmechanics.co.za to watch a video explaining the fuel-saving technologies of the Freightliner Innovation Truck.



TRENDING

Flywheel hybrids



To store kinetic energy in a battery, it must first be converted into electricity – a process that makes battery-powered hybrid cars inherently inefficient. Flywheel hybrids sidestep this problem in an elegantly simple way: kinetic energy is stored as kinetic energy, in a spinning wheel.

In specialised applications, flywheel hybrids have been in use for decades. Switzerland deployed flywheel-assisted buses in the early 1950s; an industry consortium called Flybus is currently testing a modern update on the concept. Porsche has even demonstrated the technology in a race-ready concept car, the 572 kW 918 RSR. In a much larger form, flywheel batteries serve as a grid-storage technology, holding excess energy during off-peak usage hours.

Until this year, flywheel storage in mainstream cars has been elusive. A team of car companies, including Ford, Jaguar and Land Rover, has joined with motorsports companies Flybrid Systems and Prodrive to develop a carbon-composite flywheel battery, driven by a brake-powered continuously variable transmission and housed in a partial vacuum. In real-world testing, the consortium saw fuel-efficiency improvements of 22,4 per cent over unassisted engines.

At peak power, the flywheel returned 59 kW to the car's drive train. Flywheel hybrids also promise to be easier on the environment after death. Chemical batteries require special disposal measures; flywheels don't.

TRENDING

Convergent encryption

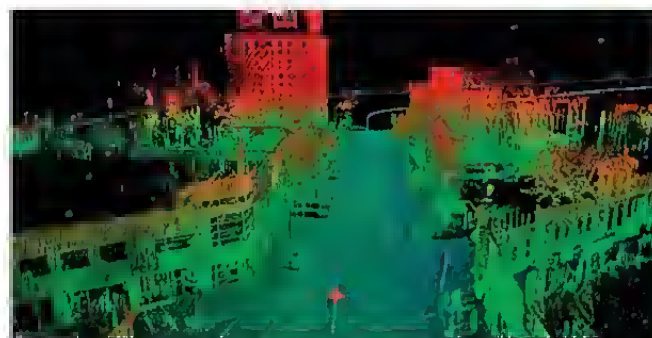
Server space, while cheaper than ever, still costs money. People have justifiable reservations about storing private data on a company's servers. But of all the hurdles faced by cloud computing services, bandwidth is the highest: it takes hours to upload one gigabyte over a typical broadband Internet connection. Bitcasa, a new start-up, is offering full cloud backup – everything on a computer – for a modest R80 a month, using a technique called convergent encryption.

Bitcasa's software assigns an anonymous hash, or identifier, to files before they're uploaded. If that hash already exists on Bitcasa's servers, it isn't re-uploaded; a popular song owned by millions would exist only once on Bitcasa's servers. This lets a Bitcasa user securely back up hundreds of gigabytes of data over an Internet connection that otherwise would have been prohibitively slow.

HAPPENING NOW

Games with a purpose (GWAPs)

GWAPs apply human intuition to computational problems. By "playing" a 3D protein simulation on their PCs, lay users decoded the structure of a retrovirus protein that had stumped scientists for years in just a few days.



BEHIND THE SCENES

MOBILE LIDAR



Unless you've recently visited the US and experienced a serendipitous treat, you probably haven't seen one of Google's self-driving cars cruising down the road – yet. Nonetheless, the search company's (mostly) driverless fleet has been quietly racking up hundreds of thousands of kilometres on public asphalt in California and Nevada. (There has been one crash, although Google insists that, at the time of impact, the car was under human control.) These autonomous vehicles depend on military-grade optical sensing technology called light detection and ranging, or lidar. The camera mounted atop Google's cars renders a 360-degree, three-dimensional view of the car's surroundings, which Google's navigational software interprets and reacts to in real time.

Where there's WATER, there's... LIFE?

Spacecraft strikes it lucky
in search for 'potentially
habitable' planets

An artist's conception illustrates Kepler-22b, a planet known to comfortably circle in habitable zone of a Sun-like star. Scientists do not yet know whether it has a predominantly rocky, gaseous or liquid composition. It's possible that the world has clouds in its atmosphere, as depicted here.

This diagram compares our own solar system with that of Kepler-22. About 2.4 times the size of Earth, the planet is the smallest known to orbit in the middle of the habitable zone of a Sun-like star.



Nasa's Kepler mission has confirmed its first extrasolar planet in the so-called "habitable zone", the region where liquid water could exist on a planet's surface. The spacecraft has also identified more than 1 000 new planet candidates, nearly doubling its previous count. Ten of these are near-Earth size, and orbit in the habitable zone of their host stars. The newly confirmed planet, dubbed Kepler-22b and located about 600 light-years away, is the smallest yet found to orbit in the middle of the habitable zone of a star similar to our Sun; it's about 2.4 times the radius of Earth. Scientists don't yet know whether Kepler-22b has a predominantly rocky, gaseous or liquid composition, but its discovery is a step closer to finding Earth-like planets.

"This is a major milestone on the road to finding Earth's twin," says Douglas Hudgins, Kepler programme scientist at Nasa headquarters in Washington, DC, adding: "Kepler's results continue to demonstrate the importance of Nasa's science missions, which aim to answer some of the biggest questions about our place in the Universe."

The spacecraft discovers planets and planet candidates by measuring dips in the brightness of more than 150 000 stars to search for planets that cross in front, or transit, the stars. It requires at least three transits to verify a signal as a planet.

Says Natalie Batalha, Kepler deputy science team lead at San Jose State University: "The tremendous growth in the number of Earth-size candidates tells us that we're honing in on the planets Kepler was designed to detect: those that are not only Earth-size, but are also potentially habitable."

> Download space wallpaper images at www.popularmechanics.co.za and set them as your desktop background.

WHERE STARS ARE BORN >

Observations made with the European Southern Observatory's APEX telescope in submillimetre-wavelength light reveal the cold dusty clouds from which stars form in the Carina Nebula. This site of violent star formation, which plays host to some of the highest-mass stars in our galaxy, is an ideal arena in which to study the interactions between these young stars and their parent molecular clouds.

The APEX observations are shown here in orange tones, combined with a visible light image from the Cerro Schmidt telescope at the Cerro Tololo Interamerican Observatory. The result is a dramatic, wide-field picture that provides a spectacular view of Carina's star formation sites. The nebula contains stars equivalent to over 25 000 Suns, and the total mass of gas and dust clouds is that of about 140 000 Suns.

NEW EYE ON THE UNIVERSE

Eager astronomers around the world are queuing for time at the world's most complex ground-based astronomical observatory, the Atacama Large Millimetre/submillimetre Array (ALMA), which has officially opened for business. This image of the Antennae Galaxies, the first to be released from a telescope still under construction, reveals a view of the Universe that cannot be seen at all by visible-light and infrared telescopes.

At present, around a third of ALMA's eventual 66 radio antennas, with separations up to only 125 metres rather than the maximum 16 kilometres, make up the growing array on the Chajnantor plateau in northern Chile, at an elevation of 5 000 metres. ALMA observes the Universe in light with wavelengths roughly 1 000 times longer than visible-light wavelengths, allowing astronomers to study extremely cold objects in space – such as the dense clouds of cosmic dust and gas from which stars and planets form – as well as very distant objects in the early Universe.

< BATTERED VOLCANO ON MARS

By Earthly standards, Tharsis Tholus is a giant, towering 8 km above the surrounding terrain, with a base stretching over 155 by 125 km. Yet on Mars, it is just an average-sized volcano. What marks it out as unusual is its battered condition. In these images, captured by the HRSC high-resolution stereo camera on the European Space Agency's Mars Express spacecraft, the volcanic edifice has been marked by dramatic events.

At least two large sections have collapsed around its eastern and western flanks during its 4-billion-year history, and these catastrophes are now visible as scarps up to several kilometres high. However, the main feature of Tharsis Tholus is the caldera in its centre. It has an almost circular outline, extends for about 32 by 34 km, and is ringed by faults that have allowed the caldera floor to subside by as much as 2,7 km. It's thought that the volcano emptied its magma chamber during eruptions and, as the lava ran out on to the surface, the chamber roof was no longer able to support its own weight. As a result, the volcano collapsed, forming the large caldera.



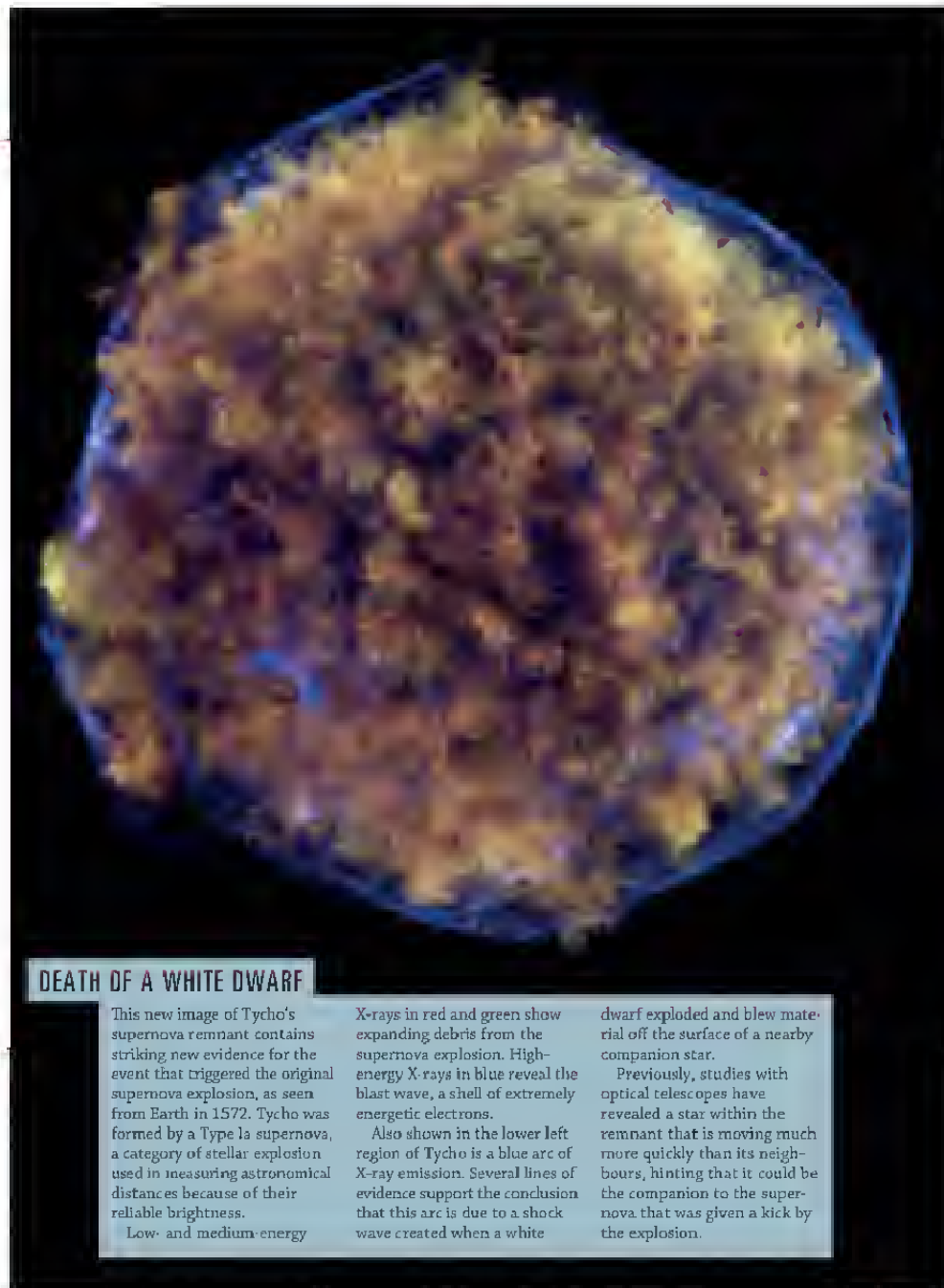
Nasa's Chandra X-ray Observatory, part of its fleet of "Great Observatories" (along with the Hubble Space Telescope and Spitzer Space Telescope), allows scientists from around the world to obtain images of exotic environments to help understand the structure and evolution of the Universe. Incoming X-rays are focused by mirrors to a tiny spot, about half as wide as a human hair, on the focal plane about 9 m away.

GALACTIC SPIDER

This star-forming region in the Large Magellanic Cloud, known as 30 Doradus or the Tarantula Nebula, is about 160 000 light-years away, and one of the largest located close to our own Milky Way. About 2 400 massive stars in its centre are producing intense radiation and powerful winds as they blow off material. Multimillion-degree gas detected in X-rays (blue) by Nasa's Chandra X-ray Observatory comes from shock fronts - similar to sonic booms - formed by these stellar winds and by supernova explosions. This hot gas carves out gigantic bubbles in the surrounding cooler gas and dust.

30 Doradus is also known as an HII (pronounced "H-two") region, created when the radiation from hot, young stars strips away the electrons from neutral hydrogen atoms (H) to form clouds of ionised hydrogen (HII). It is the largest and most massive HII region in the Local Group of galaxies, which contains the Milky Way, Andromeda and about 30 other smaller galaxies, including the two Magellanic Clouds.

X-ray: NASA/CXC/PSU/M. Townshley et al.; Infrared: NASA/JPL/PSU/L. Townshley et al.



DEATH OF A WHITE DWARF

This new image of Tycho's supernova remnant contains striking new evidence for the event that triggered the original supernova explosion, as seen from Earth in 1572. Tycho was formed by a Type Ia supernova, a category of stellar explosion used in measuring astronomical distances because of their reliable brightness.

Low- and medium-energy

X-rays in red and green show expanding debris from the supernova explosion. High-energy X-rays in blue reveal the blast wave, a shell of extremely energetic electrons.

Also shown in the lower left region of Tycho is a blue arc of X-ray emission. Several lines of evidence support the conclusion that this arc is due to a shock wave created when a white

dwarf exploded and blew material off the surface of a nearby companion star.

Previously, studies with optical telescopes have revealed a star within the remnant that is moving much more quickly than its neighbours, hinting that it could be the companion to the supernova that was given a kick by the explosion.

NASA/CXC/Chinese Academy of Sciences/F. Lu et al.

OLDEST DOCUMENTED SUPERNOVA

This image combines data from four different space telescopes to create a multi-wavelength view of all that remains of the oldest documented example of a supernova. The Chinese witnessed the event in 185 AD, documenting a mysterious "guest star" – subsequently given the astoundingly boring designation RCW 86 – that remained in the sky for eight months.

X-ray images from Nasa's Chandra X-ray Observatory and the European Space Agency's XMM-Newton Observatory are combined to form the blue and green colours in the image. The X-rays show the interstellar gas that has been heated to millions of degrees by the passage of the shock wave from the supernova.

By studying the X-ray and infrared data together, astronomers were able to determine that the cause of the explosion witnessed nearly 2 000 years ago was a Type Ia supernova in which an otherwise stable white dwarf, or dead star, was pushed beyond the brink of stability when a companion star dumped material on to it. Scientists also used the data to solve another mystery surrounding the remnant – how it got to be so large in such a short amount of time. By blowing a wind prior to exploding, they found, the white dwarf was able to clear out a huge "cavity" – a region of very low density surrounding the system.

RCW 86 is approximately 8 000 light years away. At about 85 light years in diameter, it occupies a region of the sky in the southern constellation of Circinus that is slightly larger than the full Moon.

X-ray: Nasa/Chandra and ESA; infrared: Nasa/Spitzer; Collage: B. Williams (NASA)



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COSMIC COLLISION

A composite image of Arp 147, a pair of interacting galaxies located about 430 million light-years from Earth, shows X-rays from Nasa's Chandra X-ray Observatory (pink) and optical data from the Hubble Space Telescope (red, green, blue) produced by the Space Telescope Science Institute (STScI).

Arp 147 contains the remnant of a spiral galaxy (right) that collided with the elliptical

galaxy on the left. This collision has produced an expanding wave of star formation that shows up as a blue ring containing an abundance of massive young stars. These stars race through their evolution in a few million years or less and explode as supernovas, leaving behind neutron stars and black holes.

A fraction of the neutron stars and black holes will have companion stars, and may

become bright X-ray sources as they pull in matter from their companions. The nine X-ray sources scattered around the ring in Arp 147 are so bright that they must be black holes, with masses that are probably 10 to 20 times that of the Sun. An X-ray source is also detected in the nucleus of the red galaxy on the left and may be powered by a poorly fed supermassive black hole.

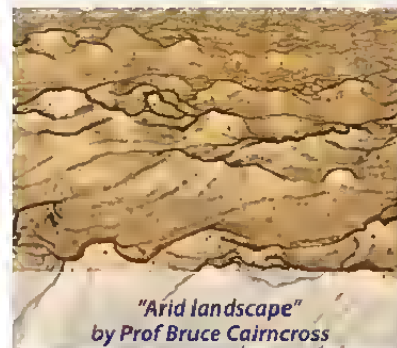
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SCIENCE AS ART



"Arid landscape"
by Prof Bruce Cairncross

This photograph looks like a desert landscape, but is actually a photo of a polished slab of sandstone from Namibia. The dark red-brown patterns are called Liesegang bands, named after a German Chemist, and they are caused by iron oxides that precipitate in the rock.

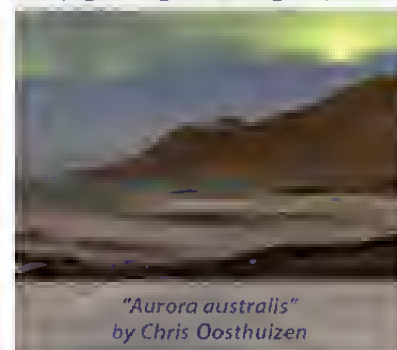
SCIENCE CLOSE-UPS



"Sponges Galore"
by Miranda Waldron

This fantastic and beautiful architecture actually shows the structural elements of tiny species of sea sponge. The structures that look like flowers and those in the spiky ball are called spicules. Different species have spicules of different shapes and sizes.

SCIENCE IN ACTION



"Aurora australis"
by Chris Oosthuizen

Aurora australis is also called the Southern Lights. This spectacular and awe-inspiring phenomenon appears in the Antarctic sky in winter. Aurora is the name given to the light that radiates from atoms and molecules in the atmosphere when they release energy transferred by high-energy particles that collide with them when entering the atmosphere at the Poles.

INTERNATIONAL YEAR OF CHEMISTRY



"The Cave of Wonders"
by Heinrich Badenhorst

A Scanning Electron Microscope allows us to see this graphite crystal at a magnification of over 30000 times. It looks like a cave of stalactites and stalagmites, but these structures can be a thousand times thinner than a strand of human hair.

To see more photos, visit www.saasta.ac.za.

The Southern African Science Lens Competition is run by the South African Agency for Science and Technology Advancement, a business unit of the National Research Foundation. The competition aims to encourage scientists to share their world through the medium of photography.



Removing yourself from the INTERNET

Leaving the Web behind might just be the key to your privacy (and sanity).

> BY JOHN HERRMAN

❖ If you've ever used the Internet, you have an online identity. Maybe it's slight: a Hotmail account here, a comment on a news story there. Or maybe you've been more prolific, leaving a trail of usernames, accounts, messages and profiles across the digital landscape. In any case, an active Internet user owes it to himself to do a bit of self-Googleing.

What you'll find will be both enlightening and humbling – even worrying. Unease about your online identity shouldn't be limited to how much information is publicly available. Online advertising is the engine that drives the Internet's largest sites, including Google and Facebook, and it depends on your personal – and

allegedly private – data for fuel. “The government, companies and marketers all want us to share as much information as possible because that's what's good for them,” says Rebecca Jeschke of the Electronic Frontier Foundation, “and it's time to think of what's good for us.”

While most Internet users seem fine with privacy trade-offs, the lack of control will lead some to consider the nuclear option: total Internet evacuation. But taking yourself offline isn't as simple as logging out – it requires a little bit of work. Here's how.

Popular sites

When a Web site is new, the last thing its creators are thinking about is how to help users leave. Thankfully, many of the Internet's largest identity properties – Facebook, Google, Amazon and Microsoft – are fairly mature and have evolved enough to offer well-defined – if well-hidden – escape plans.

If you've ever used Gmail, Google Docs, Google+ or Picasa, to name a few, then you have a Google account. Google accounts can contain an astounding amount of personal data – check google.com/dash-board to see exactly how much – but removing it is a straightforward process. Before you hit the switch, be sure to back up any information you want to keep – a Google account can be recovered for only a few months after its deletion.

Google doesn't have a software tool for exporting data from its services, but most services have their own, typically found under the Settings menu on the upper-right-hand side of the screen. As with other webmail services, the easiest way to back up your Live or Hotmail messages is to add your account to a mail app such as Outlook or Apple's Mail before deletion; this will have the added benefit of backing up your contacts.

Once you've copied your important data offline, navigate to your Google account dashboard (google.com/accounts). Next to My Products, click Edit. Then select Close Account and Delete All Services and Info Associated With It. You'll be presented with a list of Google services that you've used in the past. (In my case, this included three that I didn't remember signing up for.) Check the box next to each, along with the two are-you-really-



THE KILL SWITCH

A WEB APP TO END ALL WEB APPS

■ Signing up for social media sites is, by design, almost entirely frictionless. Three or four clicks will get you in the door, but finding your way out takes significantly more time and effort. The Web 2.0 Suicide Machine (tagline: Meet Your Real Neighbours Again) is a one-shot tool for deleting your profiles from some of the largest social sites on the Web, including Twitter, Myspace, LinkedIn and Facebook.

The tool was released last year by the New Media Lab in Rotterdam, the Netherlands, and still lives up to its name – with one exception, Facebook has taken action to disable the site's “suicide” script, and even sent the creators a stern cease-and-desist letter, demanding that Facebook be exempted from its deletion tools.

Among the concerns included in Facebook's legal letter: “The protection of users' privacy.”



sure boxes at the bottom, and select Delete Google Account. The account will be instantly wiped from the public Internet, but the company warns on its Web site that “residual... accounts may take up to 60 days to be deleted from our active servers and may remain in our backup systems”, but not be accessible in any way, “for an additional period of time”.

Until 2008, there was no obvious way to permanently delete your information from Facebook. Instead, there was a Deactivate option only, which removed your profile from public view but left it on Facebook's servers indefinitely. Thousands complained, so Facebook built a tool for permanently and instantly deleting user data – then promptly hid it away in the site's Help section.

To access it, log in to Facebook, navigate to facebook.com/help, and type “delete my account” in the search box. The top result will link you to the deletion page. Click Submit and confirm your choice, and you're done. While Facebook doesn't offer much help for backing up your data – a particular concern if you use Facebook to hold your photo collection – there are a number of free Facebook apps designed to archive your albums, such as Facebook Exporter for iPhoto and FBPhotoExport.

To pull yourself free from Microsoft's services, go to account.live.com and scroll to the bottom of the page. Under the Other Options header, click Close Account. On the following page, re-enter your account password and press Yes. Unfortunately, there is no account-wide export option.

Closing an Amazon account is a more roundabout process. Click Help in the upper-right-hand corner of any page on amazon.com and search “closing your account”. On the resulting page, pick Contact Us, then click on Something Else. Below that, select Account Settings from the menu, then Close My Account. At the bottom of the page, click Send Us an Email, fill out the form, and send.

Smaller sites

Most reputable Web sites will offer some sort of account deletion option. Smaller sites that have posted (or more likely, re-posted) your data without your permission can prove more difficult; after all, the owners never had your permission to re-publish your blog posts, photos or videos in the first place. Finding this type of information – or derogatory and misrepresentative comments about you – is no more difficult than doing a search on Google or Bing. (Be sure to place quotation marks around your name.)

Searching for yourself isn't about narcissism; it's not unusual for job recruiters, current employers or even potential dates to vet new acquaintances on search engines. A misleading search result or libellous information could cause serious distress and do damage to your reputation.

On a smaller site, sending a direct request to a webmaster to pull infringing or upsetting material is your best course of action. If there is no prominently listed contact information for the site's operator, or if you aren't able to get a response from the listed address or phone number, you can find direct contact information for the site's administrator by conducting a search on whois.net.

Domain owners are required by the Internet Corporation for Assigned Names and Numbers to supply contact information for Whois searches, including a phone number. This may at least get you on the phone with someone or give you a working

e-mail address. Whether that will be of any help is a different story. If a site refuses to take down content that belongs to you, you can try sending a takedown notice. The USA's Digital Millennium Copyright Act (DMCA) entitles users to have infringing content – images, text or video that they own, specifically – taken down. There are a number of forms available online for submitting DMCA notices to Internet hosting companies; there are even forms for asking Google, Yahoo and Bing to remove content from their search results. While these forms don't guarantee co-operation, the mere threat of legal action will at least be enough to get a site owner's attention. If a DMCA notice doesn't get a response, it might be time to talk to a lawyer.

The data that won't die

It's easy to tell when your data has been removed from public display; if you can't find it any more, then it's effectively gone. Finding out whether or not a company is still holding your data privately – or selling it to third parties – may be impossible. "There's no way to verify that your information has been deleted," Jeschke says, nor is there an overarching law or regulation governing data retention. Some data simply can't be reclaimed; you relinquished control the moment you hit Submit, after you clicked past that 50-page licence agreement.

This is a valuable lesson, and while it might not help you seize full control of your online identity, it's instructive. When you sign up with a service, make sure you trust its parent company and understand what data you're giving up. To sign up with Google or Facebook is to sell yourself in a literal way. As an astute (and anonymous) poster on the news site MetaFilter wrote: "If you are not paying for it, you're not the customer; you're the product being sold."

PM



SECURITY BLANKETS

CHOOSING AN ONLINE PRIVACY TOOL

Leaving the Internet isn't for everyone, but staying doesn't have to mean giving up on privacy and data security. Here are three tools to give you online peace of mind, from the somewhat discreet to the ultra-secure.

PRIVACY TOOLS

PRIVATE BROWSING

This feature is included in most new Internet browsers and goes by a few different titles: Private mode, Incognito mode, and InPrivate. All these names are a bit of an overreach: this mode only prevents Web browsers from collecting history and cookies. It keeps other users of your computer from seeing what you've been doing (buying gifts being the most palatable example); it won't shield your IP address or existing cookies from external sites.

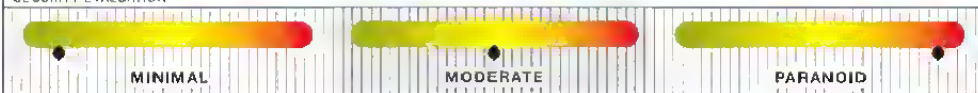
VIRTUAL PRIVATE NETWORKS

Paid virtual private network (VPN) services route your Internet traffic through an intermediary, masking your computer's address from the sites you visit. Sites will, however, still be able to deposit tracking cookies on your computer, and your browser will still be prone to exploits and viruses. VPNs reroute all Internet traffic on your computer, not just from Web browsers, which makes them popular with file sharers. Reputable services include WiTopia and Blacklogic.

COCOON (GETCOCOON.COM)

This service is a plug-in for the free Firefox browser that combines the advantages of private browsing and a VPN with extra security features. Traffic is routed through remote servers and made anonymous, and all incoming files – downloads or Web sites – are scanned for viruses and malware. Other features include throwaway e-mail addresses for spam prevention, and full portability, so you can access your Cocoon account from other computers.

SECURITY EVALUATION



Ask yourself... why do I need a

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Strangers in a strange land

> BY DAVID KUSHNER

In late 2009, a writer, a producer, a director, and three scientists sat in a Los Angeles conference room. They were discussing Marvel's *Thor* – a film based on a comic book that was in turn inspired by the Norse god of thunder – about an arrogant warrior who, at the start of the film, violates a truce by attacking the Frost Giants.

As the film team described their vision of the fight, Sean Carroll, a theoretical physicist at the California Institute of Technology, knew the filmmakers had a problem. "They wanted the Frost Giants to fall off the edge of a disc-shaped planet," he says. "That makes no sense. Where does the gravity to pull them down come from? Enough people know how gravity works that it would throw them out of the movie. You'd get a lot of giggles." Carroll and the other scientists argued their point, even though, Carroll says, "it was clear some people thought we were being uptight killjoys".

But producer Kevin Feige sided with the scientists, and in the final cut, the Frost Giants' planet was spherical. That was just one way that Carroll, a clean-cut 45-year-old who has advised on films such as *TRON: Legacy* and the TV show *Bones*, helped the production.

As punishment for breaking the truce, *Thor* is exiled to Earth. When Feige complained that using the term "wormhole" for *Thor*'s passageway to our planet was "too '90s", Carroll suggested the scientific name for the phenomenon, the Einstein-Rosen bridge. That explanation is given by Natalie Portman's character, astrophysicist Jane Foster, whose motivations Carroll helped shape.

Scientists have been helping Hollywood since the start of cinema. But as science-fiction movies account for more

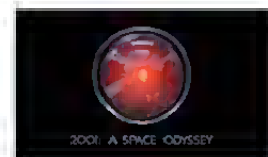
10 MOST ACCURATE

SCI-FI MOVIES

Sometimes Hollywood gets the science right – or at least not completely wrong. With input from experts, we've picked sci-fi's most plausible big-budget films. – Erik Sofge

2001: A SPACE ODYSSEY 1968

Early in the film, a character takes a routine commercial flight to a space station aboard a shuttle sporting Pan Am's logo. Swop SpaceX for Pan Am, and 2001 predicts the ambition of the private spacelight industry. Even HAL 9000's nuanced descent into lethal system error rings true. Expert opinion: "You can't train AI (artificial intelligence) for every problem it might have to solve," says roboticist and author Daniel H. Wilson, referring to HAL's response to learning that secrets are being kept from it. "Different levels of classified information are exactly the wrench that could turn a predictable learner into a murderer."



Sean Carroll (left) is a physics research associate at CalTech – and acts as a consultant on sci-fi flicks. As filmmakers try to make their movies more believable, Carroll is just one of many scientists dispensing advice. But is Hollywood willing to listen?

revenue – in the '90s, an average of six a year were in the top 50 moneymakers; that number increased by nearly 50 per cent in the first decade of the 2000s – filmmakers are turning more frequently to experts for ideas.

"The more you ground your film in the real thing, the better it plays," says DJ Gugenheim, vice-president of production at Inferno Entertainment. Scientists are willing to help Hollywood because they see a chance to expose a broader audience to science and humanise their profession. "People get images of what science is from movies," Carroll says. "I want to help get that image right."

To improve the information flow between the science community and Hollywood, the National Academy of Sciences launched the Los Angeles-based Science & Entertainment Exchange in 2008. The organisation connects filmmakers with scientists in biology, chemistry and other fields. In its first year, the Exchange's scientists consulted (for free) on 70 projects; by September 2011, on 350. Creators of TV shows such as *Fringe* and *The Big Bang Theory*, and films such as *Green Lantern* and 2012's *Battleship*, have all talked to scientists with the Exchange.

But science and entertainment don't always mix.

"Story creators might think scientists are geeks, but there's a sense of respect," says Malcolm MacIver, associate professor of biomedical engineering at Northwestern University and adviser on *TRON: Legacy*. "That respect is not always there in the other direction. Scientists feel that filmmakers dumb down everything to make a buck." Despite holding scientists in high esteem, some filmmakers find them hard to work with. "Scientists say, 'No, you can't do that!'" Carroll says. "And the moviemaker finds that unhelpful."

These days, audiences are savvier than ever. And thanks to the Internet, there's little they haven't seen – so filmmakers look to what's happening in cutting-edge research. "Scientists are more imaginative than we are in Hollywood," says Jeffrey Silver, producer of *Terminator Salvation* and *300*. "I used to say, that only happens in the movies, but now I say, that only happens in science."

The average moviegoer is also less willing to suspend disbelief. "If people see a movie and sense a disconnect between the logic of the movie and the science

that governs the world of the film," Gugenheim says, "you risk turning off the audience." Viewers take their complaints to the Internet, where they spread faster than a zombie virus. "Advisers help you construct the movie with rules that keep you in the realm of what is theoretically plausible," Gugenheim says. That's what makes films feel real – and prevents bad word-of-mouth that could cripple box office returns.

Scientists are more concerned that inaccuracies will harm scientific literacy. In *The Day After Tomorrow*, a man-made ice age occurred in just a week. It would actually take at least a decade for the real thing to set in. And when scientists in *K-119: The Widowmaker* worried that a nuclear reactor would explode, it spread a dangerous notion: damaged reactors don't explode, they melt.

Most scientists are willing to advise not only because it allows them to be gatekeepers of their disciplines, but because they want to be portrayed accurately – on-screen. "It's rare that you have a relatable character," says Sheril Kirshenbaum, a research associate at the Centre for International Energy and Environmental Policy at the University of Texas. That's why James Cameron created *Avatar*'s xenobotanist, Grace. "Scientists are usually shown as geeks or losers or evil," he says. "I wanted to celebrate the mind and the passion of a scientist."

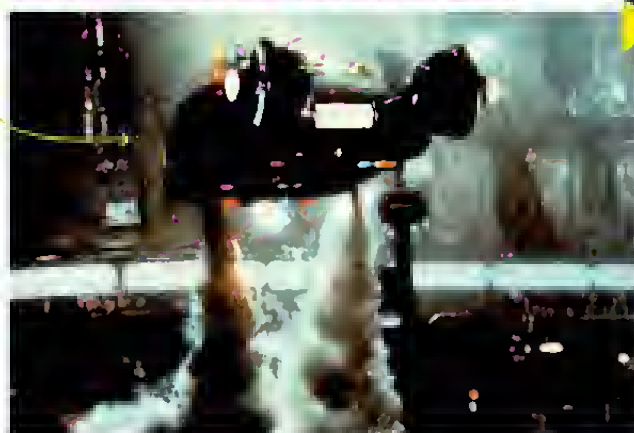
Working in Hollywood can be an educational experience for novice advisers, as Carroll discovered during his first consulting gig, on Ron Howard's *Angels & Demons*. In the film, Professor Robert Langdon tries to find antimatter stolen from CERN's Large Hadron Collider. It's a fact that when antimatter and matter come into contact, they annihilate each other in a violent explosion. What, Howard wondered, would it look like if that explosion occurred in the sky?

Carroll suggested a series of rapid booms caused by air rushing into the vacuum created by the explosion. But then the 2007 Writers Guild strike derailed both the production and his consultations. "They were over budget and behind schedule, and we didn't talk any more," Carroll says. "That's Hollywood. I was pleasantly surprised by the intellectual curiosity of those involved, but disillusioned that you can't always do it right." *Angels & Demons* eventually hit cinemas in 2009. (Carroll's contribution, he says, looked "more or less" as he advised.)

Often filmmakers ignore a scientist's

BLADE RUNNER (1982)

The heart of this neo-noir film – lab-grown replicants on the loose in Los Angeles – is no more or less plausible a premise today. But the backdrop against which they run, fight and die is a warning of urban and environmental blight. The skies over LA are blotted and pouring rain, the implied result of carbon excess and climate change. Real-life tech equivalent: the flying cars are sci-fi's most realistic airworthy transporters. These *skimmers* are vertical take-off and-landing craft – similar to Urban Aero's AirMule, from 2004, above – that require no runway, contact with the ground, control, and a pilot's license to operate.



MOST ACCURATE

CONTINUED

THE ANDROMEDA STRAIN (1971)

In this adaptation of Michael Crichton's novel, the Pentagon uses a satellite to capture an extraterrestrial virus in order to study its potential as a biological weapon. Instead, the virus runs amok, mutating rapidly and killing almost everyone it encounters.

The plot is not as far-fetched as it sounds. In the November 1962 issue of *Popular Mechanics*, microbiologist Joshua Lederberg warned that "the return of such samples to Earth exposes us to a hazard of contamination by foreign organisms... (including) the introduction of a new disease that would imperil human life".

ALIEN (1979)

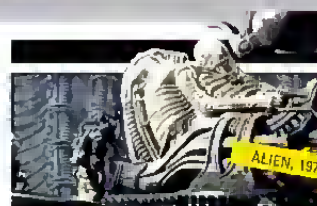
The utopian layouts and handy faster-than-light engines of most sci-fi spacecraft are nowhere to be found in *Alien*'s spaceship. The *Nostromo* is a snarl of leaking hydraulic lines, cramped eating quarters and, for long hauls, hibernation pods. Expert opinion: astronaut Tom Jones says the blue-collar craft "showed a future where space has become part of the industrial fabric. It will be a commonplace working environment, sometimes boring, sometimes dangerous, like an offshore oil rig – not an exotic lab".

GATTACA (1997)

In its opening sequence, *Gattaca* presents its society-warping concept: that rapid, ubiquitous genetic sequencing will reshape the world. Whole lives will be mapped out from birth, and a new classism will emerge, based on genetic predispositions. Real life hasn't caught up to the film's neo-fascism, but the capability is coming: the \$10 million (about \$80 million) Genomic X Prize competition hopes to yield the first system that can sequence entire genomes for \$1,000 or less.

THE TERMINATOR (1984)

This pulpy vision of AI's most unsettling endgame – that robots could rebel against humanity, a concept still called the "terminator scenario" in academic circles – was surprisingly restrained. The Skyline defence network isn't malicious and power-hungry; merely a complex program that has run off the rails.



ALIEN, 1979



GATTACA, 1997



of Earth-crust displacement. "He said, 'This could never happen'. And we said, 'Well, if it did happen, how would it work?'" Silver often talks to advisers, but even he says that "if (a story) doesn't break a fundamental law of physics, then it doesn't matter how far you stretch it".

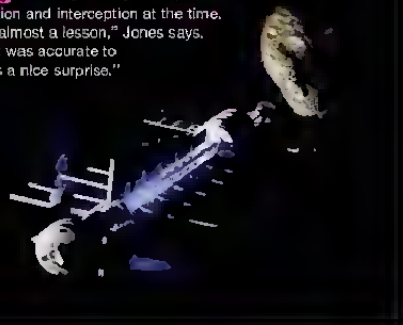
Ultimately, advisers understand they're not creating award-winning research. "You have to accept that the goal is to tell a story first," says Kevin Hand, a planetary scientist at Nasa's Jet Propulsion Laboratory. Science & Entertainment Exchange director Marty Perreault agrees: "We're not the science police." They also realise that these films could get young viewers interested in science.

"I can write a book where I explain real physics and reach several thousand people," Carroll says, "or I can help create Natalie Portman's character in a movie that will reach 10 million people. And some will be young girls who see that Natalie Portman's playing a scientist."

Now that Carroll's done with *Thor*, he's moved on to *Doctor Strange*, about a surgeon who becomes Earth's Sorcerer Supreme. Carroll's job is to apply limits to Strange's powers. "You need constraints to provide tension," he says. A world where anything can happen makes for a very boring movie. It's when science imposes boundaries on what a superhero can do that the real drama begins.

DEEP IMPACT (1998)

Although Nasa has updated its thinking on foreign-object deflection – a 2007 research paper proposed **tying a craft alongside planet-killers, tugging them off-course with gravity** – the movie was true to the technology of detection and interception at the time. Expert opinion: "It's almost a lesson," Jones says. "To find a movie that was accurate to asteroid physics was a nice surprise."



MOST ACCURATE

CONTROVERSIAL

JURASSIC PARK (1993)

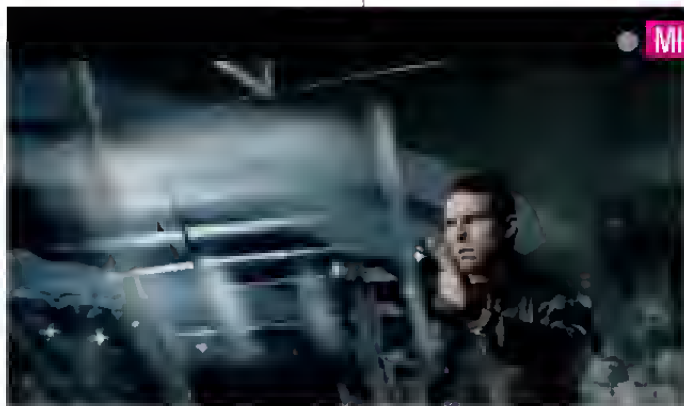
The premise of this Grichton adaptation – wherein dinosaurs are cloned using blood extracted from preserved mosquitoes – was faithful to early 1990s speculative genetics theories. But what captured imaginations were the creatures themselves, which exhibited behaviours that were news to mainstream audiences. These weren't lumbering reptiles; the *T. rex* hit near-highway speeds, with the menace of a massive avian.

CONTACT (1997)

Much of *Contact*'s authenticity goes back to astrophysicist Carl Sagan, who wrote the original novel. He understood how radio telescope arrays work and why scientists would use maths to translate an alien language. Expert opinion: even the climax – Jodie Foster's wormhole ride to a distant planet – showcases enough quantum theory, Jones says, to be surprisingly credible, "with what's known about physics, and what might be possible one day".

MINORITY REPORT (2002)

The premise – psychics who predict crimes – is ridiculous. The film's gadgets are not: self-driving cars are increasingly plausible, and the iris-scanning, targeted advertising will be in stores soon. Real-life tech equivalent: the holographic operating system. Researchers specialising in human-computer interaction still show clips of Tom Cruise swiping at mid-air applications to illustrate their goals. Microsoft's HoloDesk comes close – the research demo maps hand movements to projected images, letting users grasp virtual objects.



10 least accurate sci-fi films

These blockbusters distort research breakthroughs and transform fact-based warnings into fairy tales. – ES

THE BLACK HOLE (1979)

When the protagonists' escape pod flies into one of the Universe's most destructive phenomena, it isn't ripped apart, atom by shrieking atom. Instead, passengers have psychedelic visions and emerge safe and sound.

ARMAGEDDON (1998)

Nasa sends wildcatters to land on an earth-killing asteroid and blow it in half with a nuke – never mind that even a rock the size of Texas doesn't have the gravity to keep the rovers on its surface. Ridiculous detail: the rovers are equipped with mounted machine guns, which one character uses to open fire on everything in sight.



THE MATRIX (1999)

Nao wakas to find that the machines are using humans' body heat for power – but in reality, burning the calories pumped into people would yield more energy.

VANILLA SKY (2001)

The protagonist has been in a 150-year cryonic slumber while his neurons navigated a virtual world. But he went under in 2001, when real-life cryonics involved being decapitated and dunked in a vat of liquid nitrogen.

THE CORE (2003)

A team drills to the centre of the earth in a vessel made of unobtainium to restart the core. Ridiculous detail: the vessel is punctured by a diamond and gets dangerously hot. In reality, it would instantly fill with magma, unobtainium be damned.

THE DAY AFTER TOMORROW (2004)

The plausible theory that changing temperatures could disrupt ocean currents, triggering an ice age, is rendered absurd when physics-defying waves of cold air descend from the stratosphere to freeze people solid.

I AM LEGEND (2007)

A plague transforms humans into vampires; an immune virologist uses his blood to make a vaccine. But in real life, he'd have to be injected to create the antibodies for a cure.

INDIANA JONES AND THE KINGDOM OF THE CRYSTAL SKULL (2008)

Stuck in the blast radius of a nuclear test, Indy hides in a lead-lined fridge. He survives, and decades of high-energy physics research – which show that the lead would melt – are vapourised.

2012 (2009)

The Sun lets loose a barrage of mutated neutrinos, which superheat the Earth's core and set off a seismic apocalypse. Ridiculous detail: glacial melting triggers a global flood. But there isn't enough water on Earth to fuel such a biblical disaster.

ANGELS & DEMONS (2009)

A gram of stolen antimatter is smuggled into Vatican City. The idea that highly unstable antimatter could be transported with ease is pure scientific blasphemy. PM

WHERE *the* WIND *blows*

In pursuit of the outright world speed sailing record. No one said it would be easy...

> STORY BY SEAN WOODS > PHOTOGRAPHS BY HELENA DARVELID/VESTAS SAILROCKET

IF YOU'RE INTENT on breaking the outright world speed sailing record, you'll need a radical design – perhaps something on the lines of the Vestas SailRocket 2. But even then, as pilot and project leader Paul Larsen and his team soon discovered, breaking through the elusive 60-knot (111 km/h) barrier is far from plain sailing.

On the world stage, Namibia's small coastal town of Walvis Bay borders on the insignificant – unless you're a sailing fanatic who's addicted to speed, that is. Thanks to the predominant south-easterly winds that blow off the Namibian coastline between the months of September and December each summer, it's the ideal spot for sailors from around the globe looking for a stab at becoming the fastest man (or woman) under sail.

It comes as no surprise to learn that

Main image: The Vestas SailRocket 2 goes flat out off Walvis Bay, Namibia, while attempting to break the outright world speed sailing record of 103 km/h. Inset: Pilot and project leader Paul Larsen (second left) with his support team.

Larsen and his team are intimately acquainted with this part of the world. They last visited Walvis Bay in 2008 with their first design, the Vestas SailRocket (VSR) 1, which still holds the B class (up to 21.84 m² of sail) world speed sailing record of 87.72 km/h. Unfortunately, although they managed to hit peak speeds of 96 km/h on a number of occasions, the outright record remained frustratingly out of reach. (On their last run, just as things were looking promising, the boat became airborne, then flipped.) Dejected, everyone headed back to the drawing board, and so was born the VSR 2.

This time around, the design team opted for a different approach. Rather than chase the record with just another version of the VSR 1 hull, they wanted to create a radical "breakthrough" boat. Their aim: to overcome the inherent limit-

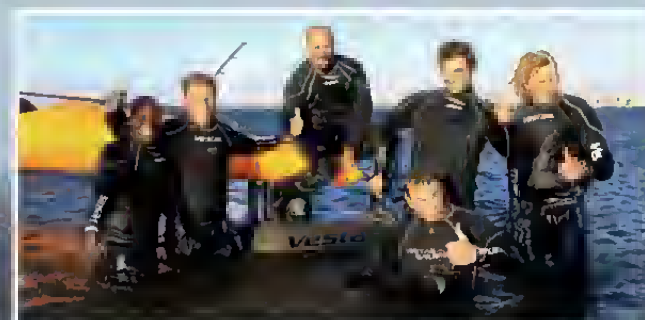
ing factors that prevented sailboats from attaining the kind of speeds that enter the record books.

Malcolm Barnsley, Vestas senior test engineer and leader of the VSR 2 design team, explains their thinking: "What we are attempting to do can be likened to that period in aviation when the focus shifted to breaking the sound barrier rather than the speed records that preceded it. If we're successful, the outright record will not only come with the territory, but the

equation for achieving 100 knots (185 km/h) or better will have been written and validated for the next generation. We do not expect this challenge to be easy, or the results to come automatically. The unexpected comes with the territory."

LIVING WITH CAVITATION

Topping the Barnsley's team's to-do list was the need to tackle the problem of cavitation head-on; they had to find a way to exploit this speed-limiting phenomenon



'What we are attempting to do can be likened to that period in aviation when the focus shifted to breaking the sound barrier rather than the speed records that preceded it.'

to their advantage. Cavitation happens wherever fluids are subjected to very low pressures (think boat propellers, hydraulic pumps and even the fins of fast-moving fish such as tuna). Because sailboats rely on fins or foils to counteract the side-force of the wind and avoid slipping sideways, when they reach speeds of around 110 km/h, cavitation raises its ugly head and effectively pulls up the handbrake.

Here's what happens: conventional foils rely on the water passing over both of their sides, much like air over the wings of an aircraft. On one side, you get high pressure that creates lift; on the other,

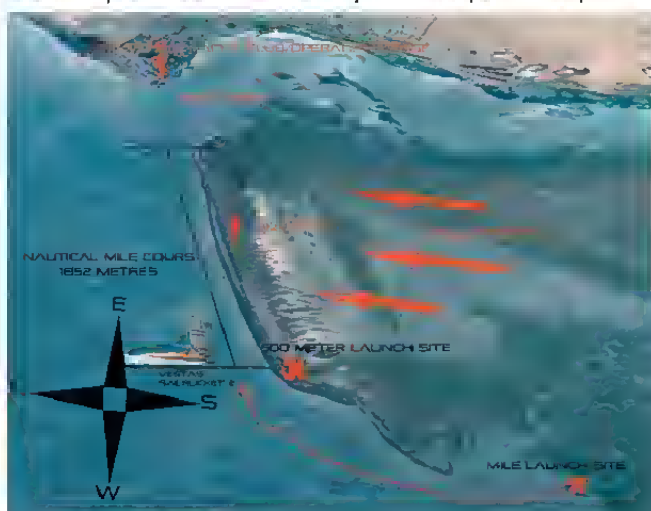
'There are many high-speed power boats that use propellers with this profile, but until now it has never been done effectively on a sailing boat.'

the low pressure actually sucks the wing upwards (or the foil sideways).

Under water, it's typically when this suction becomes too great that water turns to vapour, and cavitation occurs. The foil then



The Vestas SailRocket 2 team attack the foil with a hacksaw, hoping that by reducing its length, it would work as planned. Below: The area off Walvis Bay where the team performed their speed runs.



Left: Since the craft has to sail in only one direction to make its record runs, its asymmetrical wing is rigged for a starboard (right) tack to suit the Walvis Bay location.

loses grip on the water and the pressure side of the foil now has to do all the work; this makes it skid sideways and creates drag.

Larsen elaborates: "Imagine going for a speed record in your car, and right when you're approaching maximum speed, you open all the doors wide and pop the bonnet! Not only do you now need double the power to go any faster, but you also risk a major loss of control."

To get around this, the design team "threw out" the traditional teardrop foil profile, and instead went for a ventilated design where one side of the foil always

The IDC Green Industries Unit is providing development finance to a number of industry projects that will reduce the nation's carbon output.

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Turning renewable energy generation into a breeze





Above and below: The outlandish-looking Vestas SailRocket 2 was designed for one purpose, and one purpose only – to be the fastest sailboat on the planet.



travels in the low-pressure vapour bubble. Says Barnsley: "The profiles we chose are more like sharp wedges, where only one surface at a greater angle is utilised. There are many high-speed power boats that use propellers with this profile, but until now it has never been done effectively on a sailing boat."

ON THE LEVEL

The design team's next major consideration was stability. "The first version was a great boat, but a lousy aeroplane," quips Larsen. "This time around, we wanted the VSR 2 to be stable in both environments."

This was achieved by positioning the boat's wing at an 'inward' angle of 30 degrees to match the inclination of the ventilated foil on the opposite side of the hull. The end result is that the opposing forces of wind and water are in alignment, creating a unique stabilising effect. "It's like someone trying to shove you over by pushing at the soles of your feet. They could push you sideways, but not over. This allows us to handle a lot more power without tipping over, like 99 per cent of

other sailing craft. As a result, the only significant response to wind gusts is a change in speed."

To reduce drag and increase stability even further, both the main fuselage and beam were angled at 20 degrees to the actual point of travel. This was done to make the boat point directly into the direction of the apparent wind (or the combination of two winds – the one generated by the forward motion of the boat and the true wind itself) when travelling at high speed. Since the VSR 2 has to sail in only one direction to make its record runs, its asymmetrical wing is rigged for a starboard (right) tack to suit the Walvis Bay location.

FOILED BY THE FOIL

Larsen and his team launched their official record attempt on 18 November last year (they were allowed a 28-day window). Monitoring proceedings was Mike Ellison from the World Speed Sailing Record Council (WSSRC), the sport's governing body. Their goal: to try and break the current record of 103 km/h set by American kite surfer Rob Douglas in Luderitz, Namibia,

in October 2010. To better it, the Vestas SailRocket 2 would have to hit peak speeds in the region of 111 km/h.

Sadly, it didn't happen. Try as they might, they couldn't break through the 96 km/h barrier. In their attempts to find a solution, they experimented with different hull configurations, such as raking the beam and asymmetrical wing forward, to no avail. They made changes in the foil configuration, hoping that by angling its nose upwards as much as possible, they would be able to force its upper, more horizontal section to generate more lift and better ventilation. That didn't work, either.

Eventually, after running out of options, they had to face the unpalatable truth – the ventilating/wedge foil simply wasn't working the way everyone had hoped it would.

But these guys weren't quitters. In a last-ditch bid to salvage their record attempt, the team resorted to attacking the foil with a hacksaw, eventually removing 45 cm from its tip in the hope that this would make it lose its grip and become ventilated – but again, nothing happened.

When it comes to radical design concepts, what seems to make perfect sense in the lab doesn't always work when put to the test in the real world. That's exactly what happened here. Although the foil was designed to be ventilated, this never happened. Observed Larsen as their 28-day window of opportunity drew to a close: "It has shown itself to be relatively fast... but it won't get any records."

Finally, to add insult to injury, adverse weather over their remaining three days scuppered any chance of a last-ditch record attempt before the team's return to the UK. That's sailing for you.

To find out more about the Vestas SailRocket 2, and to read Larsen's comprehensive blog, visit <http://sailrocket.com>.

THE OUTRIGHT WORLD SPEED SAILING RECORD

The outright world speed sailing record is determined by taking the average speed of a craft between two points set 500 metres apart. All records are observed and ratified by the sport's governing body, the World Speed Sailing Record Council (WSSRC), and the title is open to all waterborne sailing craft, from kite surfers to maxi multihulls. The current record of 55.65 knots (103 km/h) was set by American kite surfer Rob Douglas in Luderitz in October 2010.

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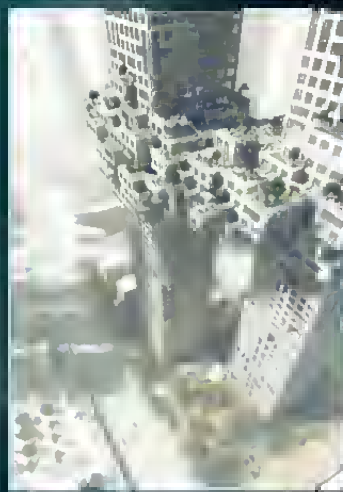
SKY-HIGH LIVING

The Cloud

Dutch architectural firm MVRDV has a new take on high-rise residential towers – the asymmetrical and distinctly intriguing twin-tower complex known as The Cloud, due for completion in the South Korean capital of Seoul by 2015. The connected towers will be built at the entrance of the ambitious Yongsan Dreamhub project, masterminded by Studio Libeskind.

The 54-storey southern tower reaches a height of 260 m and the 60-storey northern tower tops that by 40 m. About halfway up, at the level of the 27th floor, the two towers are connected by a visually striking 10-storey cluster of apartments, many featuring roof gardens. On top of the building is a series of public and private outside spaces, patios, decks, gardens and pools.

According to the people behind the project, the design is based on parameters such as sunlight, outside spaces, living quality for the inhabitants, and needs of the city itself. "It is one of many projects in which MVRDV experiments with a raised city level to reinvent the often solitary typology of the skyscraper."



Interestingly, some people made an uncomfortable connection between this project and the tragic events of 9/11, prompting the architects to issue a statement in which they apologised for any hurt feelings and explained that 'it was not our intention to create an image resembling the attacks; nor did we see the resemblance during the design process'.



INSPIRATION FROM THE ANCIENTS

Hublot Antikythera watch

We presume you've heard of the Antikythera mechanism, discovered by a Greek sponge diver in a wreck on the Mediterranean sea bed in 1901. It's one of the most mysterious objects in the history of civilisation; the very idea of a machine created in Greco-Roman antiquity did not enter the conceptual framework of the specialists of the time, and even today, obscurantist statements from non-scientists still claim that the artefact must be of extraterrestrial origin (er... it's not).

The fragments of this machine were analysed in depth, taking a multidisciplinary approach, only at the beginning of this century. It is now clear that this "astronomical instrument" dates from the 2nd century BC. Originally, it served as a calculator; its bronze gear trains were housed in a wooden box measuring approximately 33 cm x 18 cm and its case was sealed with two bronze plaques covered with inscriptions. Only 82 fragments of this machine still remain, some minuscule, all corroded: they are now on display in the National Archaeological Museum of Athens.

A genuine *cosmograph* (a machine to describe the cosmos), or more precisely, a *selenograph* (a machine to describe the movements of the Moon), the Antikythera mechanism was highly accurate and could show multiple astronomical cycles, including the Metonic cycle (named after the Greek astronomer Meton, the Saros cycle (223 lunar months, or just over 18 years) as well as the Exeligmos cycle (equivalent to three Saros cycles, or 54 years).

Where is all this leading? To a watch – and more specifically, to a rather special timepiece created by the gurus at Hublot. In creating their unique Antikythera watch, the designers had to create in a few cubic centimetres what the mechanical engineers of antiquity had developed over several hundreds of cubic centimetres, ensuring their creation was perfectly in keeping with the spirit of the original mechanism, both in terms of its accuracy and the legibility of its indications.

The hours and minutes are displayed in the conventional manner, at the centre of the movement recreated by Hublot, the movement being regulated by a conventional tourbillon whose "cage" at 6 o'clock completes one revolution in one minute. The various known indications of the Antikythera mechanism have been faithfully reproduced on its modern-day counterpart, both on the front and on the back. The primary face of the movement shows the calendar for the Panhellenic games, the Egyptian calendar (12 months each of 30 days, with the epagomenal, or additional, days), the position of the Sun in the constellations of the Zodiac, the phases of the Moon, and the sidereal year. The back of the watchmaking movement shows the Callippic cycle, the Metonic cycle, the Saros cycle and the Exeligmos cycle.

● You really need to check out this YouTube video: <http://bit.ly/xy2hS>



VIDEO > Visit www.popularmechanics.co.za to watch a seven minute film about this amazing timepiece.



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LUXURY
MIG 675

WATER, WATER, EVERYWHERE

MIG 675

A French boat manufacturer with an entirely appropriate name ("Luxury") has just produced a fast (110 km/h-plus) and richly appointed cabin cruiser with a power plant that produces the cleanest emissions imaginable – water vapour. The MIG 675 is equipped with an onboard hydrogen generator that harvests and converts seawater to feed its 372 kW supercharged engine. Cost: R2,7 million. PM

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WHEELS



ELECTRIC DREAMS

HONDA CONCEPTS

Electric propulsion dominated Honda's line-up of concepts at the 42nd Tokyo Motor Show this past December. There were a couple of new bikes, of course – of which more next month – but what really stood out were EVs of every flavour, from fold-up commuters to sporty runabouts.

EV-STER

Honda calls it "the next-generation electric small sports concept model". An electric rear-wheel-drive two-seater convertible sports car, the EV-ster combines a sports-car spirit with electromotive mobility.

Extensive use of carbon materials has helped cut weight and thereby improves efficiency, resulting in a range of about 160 km.

Steering is by twin levers rather than a wheel, and the driver is able to adjust vehicle characteristics such as motor output and suspension settings.

Top speed is 160 km/h and acceleration from 0-60 km takes 5,0 seconds. It uses a 10 kWh lithium-ion battery (maximum output 58 kW) that recharges in less than 3 hours at 200 V.

AC-X

This next-generation plug-in hybrid vehicle is designed to improve on occupant comfort and driver enjoyment in a variety of driving situations, whether in-town or out. It offers "engine drive mode" for more aggressive driving or an "automatic drive mode" for more relaxed driving.



TOWNWALKER

Hop on, and it's hip urban transport. Fold away the steering and seat, and it can be easily loaded in your car for the trip back home.



E-CANOPY

Honda's vision of a next-generation commuter is basically the company's unique three-wheeled scooter with an EV powertrain. Although it's designed for personal use, it can be used as a delivery vehicle: a storage "boot" can be added.



MOTOR COMPO

To start off with, it's a compact EV two-wheeler commuter. But wait, there's more: loaded into the **Micro Commuter**, its detachable battery can be used as a power source.

MICRO COMMUTER

Being a multifaceted company – spanning bikes, cars, power, boating and aircraft – Honda was able to combine the creative input of its car and motorcycle R&D centres to create a micro-sized, futuristic, electric city commuter. It's said to offer a new type of communication between people and mobility and an exterior that the owner can customise casually. The bike/car collaboration came in handy when integrating the **Motor Compo** (see below) two-wheel EV commuter with the Micro Commuter.





SHAPESHIFTER

RINSPEED DOCK+GO

Hey, if a backpack works for humans, why not for cars? Frank M Rinderknecht's latest offbeat idea puts a new spin on the trailer. Due to be launched later this year at the 2012 Geneva Show, Dock+Go is a modular system that doubles up on a car's rear axles when extra load-carrying is needed.

It all sounds pretty much like a conventional trailer – except that the Rinspeed idea is integrated with the tow vehicle's styling. Single-axle "packs" serve a variety of purposes, according to Rinspeed, including cleverly solving the vexing operating range problem of electric vehicles. If you don't need the extra space (or weight), you simply don't take the "pack" along with you.

Although any electric city car could serve as the basis for Dock+Go, the demo version involves the electric version of the smart two-seater. In Rinspeed's words, "A wide variety of 'packs' turn the electric-powered mini car into the dream car of any pizza delivery driver – complete with an integrated heated box. For craftsmen there is a toolbox pack with well-organised spaces for every tool. And after the day's work is done the shared or owned camping, golf, skiing, beach or party pack is docked to the rear of the mini-mobile."

As for the question of range extension, an "energy pack" with a combustion engine or range extender, packed with batteries or powered by a fuel cell, is



envisaged. What's more, the docked third axle drives the rotating second axle and thus recharges the EV's battery. Rinderknecht calls this recharge concept the Vario-Hybrid.

BACK TO THE ROOTS

2012 SUBARU IMPREZA

The 2012 Impreza has gone back to its econobox roots. Although it still comes standard with all-wheel drive, it sports a smaller, less powerful 2.0-litre engine (110 kW and 196 N.m) than last year's model and has a new give-me-a-minute-to-think-about-it exterior. Efficiency, however, is vastly improved. The car is 75 kg lighter, and this, plus the new engine, boosts fuel economy a whopping 30 per cent with a five-speed manual. The CVT option works fine in normal use, but it's not a good complement to the car's sporty handling: the transmission feels slow to alter the ratios.

The roomy interior has been upgraded with the addition of soft-touch materials, tilting headrests, and a separate info display above the centre stack in all models, but the base model's centre stack and dash feel and look dated. Still, when it comes to all-weather performance and versatility – especially for the five-door hatchback – the Impreza is a solid entry. — JAMES TATE



WE CAN DO BIG, TOO

PEUGEOT 508

It's been a while since we have been exposed to a bigger Peugeot that isn't an MPV. With the 508, Peugeot has blended an upmarket feel with real elegance that deserves a look from those who prefer something a bit out of the ordinary in a sedan.

Our Southern Cape launch route showed off the 508 as a relaxed long-distance cruiser on the quieter back roads. Yet when the going got twisty it didn't lose any of that composure. The car's balance is superb, at least the equal of some more snooty makes, and the performance from the 2.0-litre Four is entirely up to the job. Interior fit and finish are top-class, too.

Of course, style and competence alone don't necessarily cut it if you're aiming for the Establishment. In addition to its aim of providing a credible alternative to the German brands, Peugeot is also targeting the marque's poor local resale value. And on top of all that the 508 features a generous quota of high-tech. In the GT, besides all the usual exu-toys, the driver gets powered lumbar massage seating and a colour Head-Up Display (optional on other derivatives), offered in conjunction with sat-nav. There's also a JBL high-performance audio system.

The South African distributors expect modest sales of about 40 a month, with four versions being



offered at launch. There are three engines: a 1.6 THP in manual or auto, a 2.0 HDi manual and a 2.2 HDi Auto in the flagship GT model. Besides the 150 kW and 450 N.m output of the 2.2 engine the GT also gets double wishbone suspension in front. It's sleek and efficient, too, with a drag coefficient quoted at 0,26.

One model we won't be getting is the wagon version: South Africa just isn't wagon territory, says new local MD Francis Harnie. That's a pity, because if anything the wagon is even better looking than the sedan. What's more, it comes with the innovative Hybrid4 diesel hybrid 4x4 drivetrain launched towards the end of last year on Peugeot's 3008.

Prices range from R283 700 to R409 900, which includes a 5-year/100 000 km maintenance plan.



FISKER KARMA

FRISKY PLUG-IN

No 2 250-kg luxury sedan with a 3,15-m wheel-base and 22-inch wheels has a right to be this athletic, smooth and collected, whether hustling or cruising. The Karma, Fisker's first car, is a plug-in hybrid.

A pair of 150-kW electric motors drive the rear wheels, and when the 22-kilowatt-hour battery pack is depleted (after roughly 80 km) or when the driver calls for full power with the Sport mode, a GM-supplied turbo four-cylinder fires to spin a generator. We love this car's dual personality, Bentley beating interior, solar panel-covered roof, and the sexiest silhouette this side of Scarlett Johansson. But oh boy, that petrol engine is a noisy beast when it's running. Fisker says a fix is in the works. We hope that's true, because the Karma could, like the Volt, change the way drivers perceive EVs. — COLIN MATHEWS



2012 FISKER KARMA

Powertrain	Two 150-kW AC electric motors powered by a 22-kWh battery pack and a 194-kW petrol engine backup generator
Transmission	Single-speed
EV range	80 km
0-100 km/h	5,9 seconds

LOOK AND LISTEN

AUDI CONNECT

It wasn't so long ago that we were still trying to wrap our heads around carphones. Now Audi's latest tweak to its connected car system logs in Internet radio and Google Street View (depending on available broadband data options, of course).

Tune in online. There's in-car reception of over 4 000

Internet radio stations worldwide through the new "Audi music stream" app, which lets drivers tune into radio stations via the Internet and store them in their Audi infotainment system. A driver's smartphone can be connected to an MMI navigation plus system via WLAN. If there is nothing worthwhile on the radio, just access the phone's music library wirelessly via the MMI, choose a file and play it.

Enhanced navigation. We've become accustomed to Google Street View showing us what a location actually looks like at street level – on our home PCs or laptops. Integrating this with Audi Connect means you can now view high-resolution

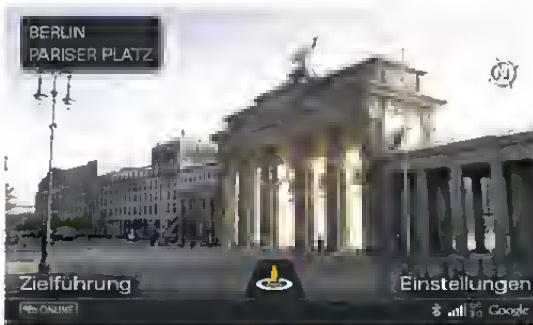
aerial and satellite images, photos, land formations, streets and their names as well as business information in your car.

The system pre-loads data for your selected route and merges them with information from MMI navigation plus. The Bluetooth online car phone's UMTS module makes true-to-life 360° panorama pedestrian's eye-view images available in-car.

Audi connect stands for connected mobility combining all applications and developments linking existing and future Audi models to the Internet, to their owner and to the surrounding infrastructure. A built-in UMTS module and a customer's SIM card on-board

the car integrate online information such as navigation with point-of-interest search, Google Earth images and Street View, weather, news, Audi traffic information online or Audi music stream, directly into Audi's optional MMI navigation plus.

A WLAN hotspot connects mobile devices to the Internet from the rear seats while driving or from all seats when the car is stationary.



STOP RIGHT THERE

BIKE ABS MANDATORY?

Motorbikes over 50 cm³ could be forced to have ABS anti-lock brakes in Europe – including scooters, quad bikes and mopeds. The European Parliament's internal market committee recently voted for the move in a regulation that covers both safety and vehicle emission standards. According to S&D group negotiator Kerstin Westphal, "This EU regulation is a life-saver. The ABS system for motorbikes and scooters is no bigger than a teacup – but it will save the lives of 500 bikers a year." Road deaths fell in the region last year, but motorbike deaths jumped about 10 per cent. Studies show that ABS could cut the death toll by 20 per cent.

One jump ahead of that is BMW, whose new maxi scooters incorporate ABS as standard. These two premium models are the first fruits of BMW's response to growing traffic volume, rising energy costs, and ever tougher CO₂ regulations: an expansion into the urban mobility sector.

The new C 600 Sport and C 650 GT are fitted with a generously sized braking system



BMW C 650 GT

consisting of a two-rotor disc brake at the front and a single disc brake at the rear, each 270 mm in diameter. They're said to combine motorbike ride qualities with the agility and comfort of a scooter. Both use a fuel-injected 44 kW 650 cm³ two-cylinder inline engine with CVT.

LIGHTS OUT

APTERA EV

As the traditional automotive big guns ease their way into EV and alternative-fuel technologies, the new wave of enthusiastic start-ups founded on an all-alternative premise aren't necessarily enjoying mass buy-in.

After a high-profile start, EV manufacturer Tesla isn't where it hoped it would be, and South Africa's own Joule has yet to get to market two years after its launch. The latest casualty is one-time X-prize contender Apera.

Honoured with a **PM Breakthrough Award** in 2008, Apera went into liquidation in December. CEO Paul Wilbur said that despite conditional backing of about R1 billion from the US Department of Energy the company had been unable to attract the extra capital it needed.

Wilbur said the company had come tantalisingly close to reaching its goal. Its first product would have been a mid-size five-passenger sedan (similar to a Toyota Camry) that would be base priced at less than \$30 000 (about R240 000) and deliver better than 1,25 litres/100 km equivalent.

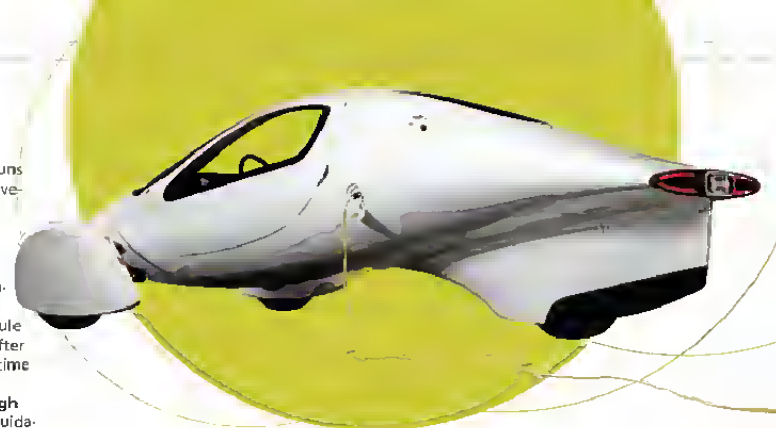
The company had gone as far as entering discussions to reactivate a mothballed GM plant in Ohio. It continued develop-

ment of its patent-pending composite manufacturing system that enables energy efficient vehicle production by drastically reducing vehicle weight – by as much as 30 per cent – while tripling its strength. This system effectively did away with the need to paint the vehicle, resulting in a massive production saving.

According to Wilbur, the Apera formula of aerodynamics plus lightweight design through composites delivered measured efficiency of about 1,15 litres/100 km in tests at Argonne National Labs. In recognis-

ing it with a Breakthrough Award, PM declared that the Apera Typ-1e (above) "could prove revolutionary, opening up a new automotive category of ultra-high mileage cars designed for real-world drivers and – at R264 000 – priced for them, too".

However investors clearly were twitchy about the perceived low volume return of the company's original three-wheeled design, so they reprioritised their product plan to four-door sedans. Sadly, that more practical approach wasn't enough to attract the backing they needed. PM



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CAR's annual TOP 12, in association with FNB Vehicle Finance, will again recognise the best buys in twelve segments of the new vehicle market and announce the magazine's industry awards, which include the Motor Company of the Year Award, Technical Innovation of the Year Award and Safety Award.

Oklo genesis?

It's a startling concept by anyone's measure, but more than one scientist is putting two and two together... and coming up with the same question: could natural nuclear reactors have triggered the start of life on Earth?

> BY CLARA MOSKOWITZ

If you thought all nuclear reactors were made-made, or buried in the hearts of stars, you'd be wrong. Evidence for a cluster of natural nuclear reactors has been found on Earth, and some scientists say our planet may have had many more in its ancient past.

There's also reason to think other planets might have had their own naturally occurring nuclear reactors, although evidence for this is hazy. If they did exist, say experts, the large amounts of radiation and energy released by such reactors would have had complicated effects on any developing life.

Natural nuclear reactors occur when deposits of the



No natural reactors exist today, as the relative density of fissile uranium has now decayed below the level needed for a sustainable reaction. Pictured here is Fossil Reactor 15, located in Oklo, Gabon. Uranium oxide remains are visible as the yellowish rock.

radioactive element uranium build up in one spot, and eventually ignite a self-sustaining nuclear-chain reaction where uranium divides in a process called fission, producing other elements. The

reaction releases a powerful punch of energy—energy that could prove beneficial or highly detrimental to developing life, depending on the circumstances. (The jury is still out on this one.)

Only known example

The only known examples of natural nuclear reactors were found in the Oklo region of Gabon, Africa, in 1972. French miners discovered that the uranium samples they extracted were depleted in the rare isotope uranium 235, the only naturally occurring material on Earth capable of sustaining fission reactions. It was as if the material had already gone through a nuclear reaction and been used up.

"In fact, that's the scenario most supported by studies. Scientists think a concentration of uranium 235 in that location went critical about 2 billion years ago and underwent fission, just as it does inside man-made nuclear

reactors. "As far as we know, we have evidence of natural reactors forming and operating only at the one site in Gabon, but that demonstrates that it's possible, and our calculations suggest it was much more probable earlier in Earth's history," said Jay Cullen of the University of Victoria in Canada.

Cullen and Laurence A. Coogan, a colleague at the University of Victoria, researched how likely these reactions were when Earth was much younger, based on how much uranium in a given area is necessary for the material to go critical and start a self-sustaining fission reaction. They found that during the Archaean epoch, between about 2.5 billion and 4 billion years ago, natural nuclear reactors may have been relatively common.

"It certainly seems more than likely that these sorts of reactors would have been much more common in Earth's early history because the amount (of uranium) you need is actually quite small," Cullen told *Astrobiology Magazine*. However, because the time scale is so vast and

the geological record so poor, scientists have very little chance of confirming this idea.

Spark of life

If natural nuclear reactors were indeed present on early Earth, they could have had interesting effects on any nascent life. The ionising radiation released by a nuclear reaction can damage DNA, the precious instruction code built into every living cell. If organisms were living too close to the site of a reactor, they could have been wiped out completely. However, life hanging out on the outskirts of a nuclear reactor might

have received a smaller dose of radiation—not enough to kill, but enough to introduce mutations in the genetic code that could have boosted diversity in the local population.

"The ionising radiation would actually provide some genetic variation," Cullen explains. "That's the quantity that natural selection is going to act upon, and with time, it might help to promote change in organisms. I think that most people view ionising radiation as a bad thing, but that's not necessarily so."

Furthermore, some scientists think the nuclear reactors themselves could have provided

an even greater boon to life by giving it the spark it needed to originate in the first place. Zachary Adam, now a graduate student at Montana State University in Bozeman, suggested the possibility in a 2007 paper in the journal *Astrobiology*, which he wrote as a graduate student at the University of Washington.

Scientists don't know for sure how life got started on Earth, but some think it required a burst of energy. This energy would have been required to break the bonds of simple elements such as carbon, nitrogen, hydrogen and oxygen, so that they could recombine to form the first complex organic molecules. Other researchers have suggested that a lightning strike might have provided the requisite energy, but Adam thinks the energy released by a natural nuclear reactor is more likely to have provided the catalyst.

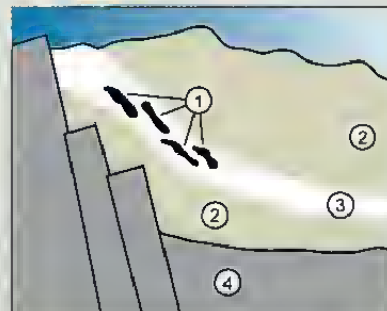
"I think it is at least as possible as other ideas, if not more plausible, but I realise everyone is partial to their own ideas."

● Source: *Astrobiology Magazine* PM

US Department of Energy



Alexander Meshik (foreground), Charles Hohenberg and Olga Práviditsseva combined a selective laser with ion-counting mass spectrometry to find out how the world's only natural nuclear reactor worked. They determined that the Oklo reactor, which comprises several separate sites, ran for 30 minutes, then shut off for 2.5 hours before starting over. And it did this for two million years.



- 1 Nuclear reactor zones
- 2 Sandstone
- 3 Ore layer
- 4 Granite

ROBERT D. LUSKOWSKI

DAVID KLINGHOFFER



Is hacking wicked and antisocial, or cool and geeky? A brief history of tech's most two-sided term...

THE WORD HACKER has been everywhere recently, splashed across the front page for weeks as the "phone hacking" scandal at *News of the World* engulfed Rupert Murdoch and his media empire. There is a sensational mystique to the term that makes it irresistible to journalists.

But typing the default password "1111" into the voicemail box of a murdered girl is not hacking. Neither is bribing the police for the phone numbers of celebrities and crime victims. Unless we're ready to call smashing the window on my Honda Civic "car hacking", nothing in the News Corp scandal fits the bill.

"If it had been me, I would have broken into the phone company system so I could have had direct access to the messages of all their customers," says Kevin Mitnick, who was for several years the most-wanted computer criminal in America, after hacking into the voicemail computers at Pacific Bell. "What News Corp did... guess pin codes, spoofing voicemails... that's amateur script kiddie stuff."

Mitnick, who now works as a security consultant and recently published a new book, *Ghost in the Wires*, said he's disappointed to see what passes for hacking these days. "I can remember writing a

program in high school that was supposed to calculate 100 digits of the Fibonacci Sequence. It did that, but of course, it also stole passwords from my professor and classmates. But I didn't get in trouble for that; I got an A, because my teacher recognised it was smart. That's what hacking is supposed to be about – not crime, but innovation and creativity."

In the 1950s, on the campus of the Massachusetts Institute of Technology, a great "hack" meant a practical joke; covering the campus dome in tin foil, for example. Among the nerdy members of the Model Railroad Club, a hack came to mean a feat

of technical skill, a particularly sweet switching station or miniature drawbridge. As these young geeks moved from laying track to working with computers, training massive IBM mainframes to make music and play chess, they took this attitude and vernacular with them.

Ruining it for the rest of us

The word hacker began to mutate, like a quartet of teen turtles, during the late 1980s and early 1990s. What had been a compliment among programmers and

engineers became a byword for cyber crime. Hollywood played a big role: films such as *WarGames* and the eponymous *Hackers* made the word synonymous with mischief and mayhem.

The laws that sprang up to combat the rising tide of cyber-crime followed suit. "Hacking is breaking into computer systems, frequently with intentions to alter or modify existing settings," according to the National Conference of State Legislators in the US. "Sometimes malicious in nature, these break-ins may cause damage or disruption to computer systems or networks."

A Google Trends chart of the period between 2004 and today shows the prevalence of hacking in the press isn't just anecdotal; news coverage of hacking over the past three years has grown by leaps and bounds. Some of this coverage has been about *real* hacking. The attacks that penetrated Google's systems in China and caused the search giant to pull its business out of that country. The infiltrators who stole sensitive data from hundreds of thousands of Sony customers. And the hack-tivism by Anonymous and Lulzsec that defaced Web sites of major governments and corporations.

But just as often, hackers have been convenient bogymen. For example, it turned out to be Representative Anthony Weiner himself, and not a hacker, who posted a photo of the US congressman's ex... package to Twitter (if you missed the story, Google his name). When Pfc Bradley Manning was arrested for passing classified military documents to Wikileaks, news sources such as *Wired* and CNN speculated that Manning had learned the dark arts from MIT students he partied with at a "hackerspace" workshop in Boston. The banal truth was that an angry young man

with access to information downloaded sensitive files and burned them to a CD. Writing Lady Gaga on the disc was a nice bit of misdirection, but hacking it was not.

The sad reality is that cyber-crime is on the rise. And in fact, News Corp has engaged in computer hacking. As *The New York Times* recently pointed out, the company paid \$29.5 million (about R235 million at the current exchange rate) back in 2009 to settle charges that it hacked into the computer system of a New Jersey-based company called Floorgraphics and stole

code, and at the end you have a product. Hackathons are these things where all of the Facebook engineers get together and stay up all night building things – and I do too. Usually I code alongside everyone."

Zuckerberg's comment highlights an interesting divide. Says author Steven Levy, whose 1984 book, *Hackers*, first introduced the term to the mainstream: "The word now has two branches; the one used among computer programmers and the one used in the media. On one hand, it means 'to create'; on the other, 'to steal'."

Zuckerberg: 'To hack means to build something very quickly.'

information for a smear campaign that cost the small advertising company several major clients.

There were no 9/11 victims involved, no celebrities or young murder victims, and so the story went largely untold. Hell, the head of US cyber security, Randy Vickers, resigned last year in the aftermath of hacking assaults on the US Senate, FBI and CIA Web sites. Yet the only major publications to carry the story so far have been foreign outlets, Reuters and *The Guardian*.

Hackers are like Jedi, wielding mysterious powers that enable them to peer into the private lives of normal people. Just as there are Jedi on the light and dark side, so hackers are divided into white and black hat, a porous boundary that contributes to confusion around the term.

Before he built computers, Steve Jobs and his partner Woz built blue boxes that helped phone phreakers hack their way to free long-distance calls. And the most widely known and admired young entrepreneur of this generation, Mark Zuckerberg, has dark hacking in his DNA. He didn't ask for permission when he took the names and faces of his classmates and put them together into Facemash, an early experiment at Harvard that nearly got him expelled.

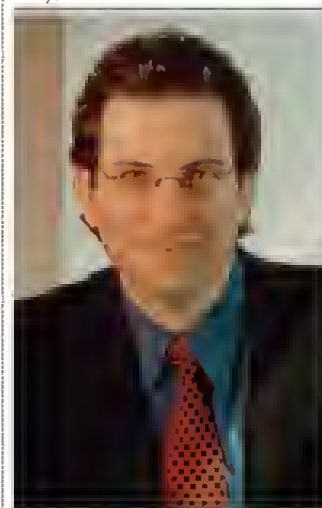
But when Zuckerberg sat down a while back with Leslie Stahl for a 60 minutes interview, he tried to explain to her that Facebook was strictly white hat. "The graffiti is largely gone," Stahl said to Zuckerberg during her tour of Facebook's fancy new offices, "except for one word you just can't miss. I see 'hack' everywhere. Hack! It has a negative connotation, doesn't it?"

Replied Zuckerberg: "When we say hacker, there is this whole definition that engineers have for themselves; it's very much a compliment. To hack means to build something very quickly. In one night, you can sit down and churn out a lot of

Adds Levy, who wrote in an update to the 2005 edition of his book that he had considered dropping the word altogether: "There was a time when 'hacker' had lost almost all of its positive connotation. But the community seems to have really reclaimed it for themselves, and that has spread... to the point where people talk about hacking healthcare or hacking education, and they mean working to make it better."

Without a doubt, I've been guilty of misusing the word 'hacker' in the past. But I won't any more. Hollywood screenwriters and harried journalists take note, lest you become hacks of an altogether different sort.

● First published in *The New York Observer*. Also see this month's cover story, "The Secret War".



Kevin Mitnick, quintessential hacker.



In the rough

Off-road adventuring

DOWNSIZE ME

Compact and mid-sized SUVs have several advantages over their full-sized counterparts. They're not nearly as intimidating to drive and park, they're more economical, and they tend to be more pleasant to drive on-road.

If you think that full-sized 4x4s are seldom used in anger in the wild, it's even less likely, then, that you'll find the abilities of a "soft-roader" being tested to the limits. Many compacts are surprisingly capable in the rough, though – and today's modern designs are not only trendy, but also remarkably versatile. That's as true for the mainstream designs featured here as it is for the concepts in our line-up.

CLEVER CAT

Ford Kuga

What Ford calls Intelligent 4WD is the Kuga's trump card off-road – to go with its already impressive on-road behaviour. Normally in front-wheel drive, the on-demand rear-wheel-drive system channels torque to the rear wheels as needed to optimise traction without sacrificing fuel economy. The 2.5-litre Duratec Turbo petrol engine produces 147 kW and 320 N.m, with a combined fuel economy figure of 10,3 litres/100 km and CO₂ of 244 g/km.

Practical features on the Kuga range from a split rear entry with separate access to upper tailgate or both sections, to second row underseat storage and D-ring tie-down points. It's big on safety, with disc brakes all-round, anti-lock braking and stability control with rollover mitigation. Tech features include Bluetooth with voice control, rain-sensitive wipers, auto-dimming rear view mirror, and rear parking sensors.



SADDLE UP

Chevrolet Trailblazer

Chevrolet's all-new Trailblazer is coming to South Africa, the local distributors have confirmed. Unveiled at the recent Dubai show, the 7-seat Trailblazer is described as Chev's toughest, most refined midsize SUV. It goes on sale early this year.

Developed by GM Brazil on the same platform as the all-new Colorado pick-up, the Trailblazer is said to combine heavy-duty off-road capability with refined city driving. Drivetrain options will be revealed later; the vehicle shown at Dubai had an all-wheel-drive system and a new 2.8-litre diesel with variable-geometry turbocharger.

GM is particularly proud of the flexible seating, saying the third-row accommodation "isn't an afterthought. It's an authentic third row where people can sit comfortably for long trips".

DO IT IN REAL TIME

Honda CR-V

According to Honda, its fourth-generation CR-V boasts advances across the board, notably in design, packaging and technology. They spotlight aerodynamics, economy, ride comfort, a more spacious interior, and a 65-dm³ cargo area (despite smaller exterior dimensions).

A new 2-litre i-VTEC engine with CVT and front-drive joins the 2.4-litre 4WD. It's said to equal the acceleration of the bigger-engined model, which gets a more advanced engine with 10 kW higher output than before, plus a 5-speed autobox.

Intelligence is clearly a big deal here. Real Time All-Wheel-Drive features what Honda calls its Intelligent Control System to manage pullaways on slippery surfaces, improve cornering and enhance stability on slopes.



SKY'S THE LIMIT

Mazda CX-5

This is the first Mazda to fully encompass SkyActiv technology (full details in New on the block, January 2012), the brand's engineering-focused philosophy towards improving all-around vehicle efficiency. Mazda also claims best-in-class fuel economy. SkyActiv tech in the company's new 2.2-litre diesel scheduled to be used in the CX-5 in 2013 meets new emissions regulations while producing a hefty 450 N.m of torque and revving to 5 000 r/min.



CUTTING-EDGE DRIVETRAIN

VW Cross Coupé

The Cross Coupé's striking styling, a visualisation of a crossover between a four-door coupé and a compact SUV, is said to hint at VW's future designs. But there's a lot more to this concept. It marks the first time a model featuring the new modular transverse matrix (MQB) system has gone on show to the public; its plug-in hybrid powertrain features three drive sources:

- A 110 kW direct injection turbo petrol engine;
- A front-mounted 40 kW/180 N.m electric motor;
- An 85 kW/270 N.m electric motor mounted coaxially with the rear wheels.

When the rear axle is driven by the rear of the two electric motors, power is supplied by the motor at the front, acting as a generator powered by the TSI engine. Overall system output is 195 kW; it can travel up to 45 kilometres on electric power alone.

The space that would have been taken up by a front-rear propshaft houses the lithium-ion battery, with the dual benefit of good packaging and good weight distribution.



Celebrating a legend

Many have called it the ultimate 4x4. In the Unimog's 60 years of existence, this all-wheel drive legend has done duty in every discipline from forestry to fire-fighting to railway maintenance – and even been converted for use as a go-anywhere camper. Now a striking design study has won a prestigious red dot award in Singapore. Although it is not intended as a prototype for future Unimogs, Mercedes-Benz says it points the way to the company's design direction for commercial vehicles.

Since the first Unimog (the name comes from the German for "Universally Applicable Motorised Implement") rolled off the production line in 1951, more than 380 000 have been built.

The current concept picks up familiar unique Unimog cues, from high ground clearance to coil springs, frame design and chunky bonnet. The green colour was deliberately chosen to evoke the colour of the very first Unimog, though the design study takes its tint inspiration from the arrow poison frog, a rare amphibian.



Get a roof over your saddle

Beasts of burden were so precious to our forefathers that special attention was paid to their needs. In the modern age, sadly, we're apt to skimp on caring for our uncomplaining mechanical steeds. That said, we'd agree wholeheartedly with Redverz Gear's view that, because an extended tour on a motorbike is an experience unlike any other, it's worth giving your machine the kind of care you would lavish on any vital travelling companion. That includes giving it appropriate shelter.

Redverz Gear started out as The Nomad Tent Company, which kind of says it all, really. The company's Series 2 Tenere Expedition Tent is big enough for you and your bike, so you can tinker and carry out running repairs and maintenance in comfort, thanks to a separate "garage" section. It's based on an idea dreamed up by an adventure photographer who needed lightweight shelter to keep his bike and gear safe. Big enough for two people, it has stand-

up space for anybody up to about 1,85 m tall, yet rolls up to sleeping-bag-size and weighs a modest 6 kg. It can be set up by a single person, and when they say it fits a bike, they mean a full-size cross-country model such as the BMW GS or KTM, complete with storage boxes, and perched on its centre stand.

Price: about R3 600. To find out more, visit redverz.com.



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Mini inflator

There's nothing quite like hitting a long dirt road on a torquey two-wheeled monster, especially if dumping accumulated stress and regaining a sense of freedom is high on your agenda. Then again, there's nothing quite like picking up a puncture in the middle of nowhere to put a damper on your long-awaited bike adventure.

However, all you need do is take the Slime Power Sport tyre inflator kit, and your problems (puncture-wise, at least) are sorted. Inside the rugged, compact case (it measures 15 x 15 x 6 cm), you get a 20 bar air compressor that runs off 12 V power. Various interchangeable power connectors are provided, so you can hook it up to multiple power sources, making repairs on the fly almost child's play.

Price: about R450 (excluding Slime sealant). Contact AMP on 011-259 7751 or visit www.amps.co.za.



Do it by hand

An impressive-looking powered winch mounted on a sturdy aftermarket bumper certainly boosts your standing in the 4x4 world. Less obvious, but no less indicative of your off-road cred, is the "wire rope" hand winch like the one sold by Securetech. Of course, because it is entirely human-powered, it also demonstrates that you're not afraid of hard work.

The unit comes with a cable and a handle for winching in and out. Jaws in the winch grip and move the cable as the handle is cranked. Naturally, because of the tension involved in winching – even hand winching – the usual safety equipment for winching and recovery apply: gloves, a safety lanyard and a recovery blanket. A snatch block can be used in conjunction with the winch, and to lengthen a cable, you can safely use a pull strap.

For safety, shear pins are built in to the crank: overstress the unit and the pins shear, locking the jaws on the rope. Replacement pins are contained in the carry handle.

A typical mechanical winch can be ordered complete with mounting brackets, covers and spools for the cable. Being portable, it can be lashed anywhere that's convenient, be it inside or outside your vehicle.

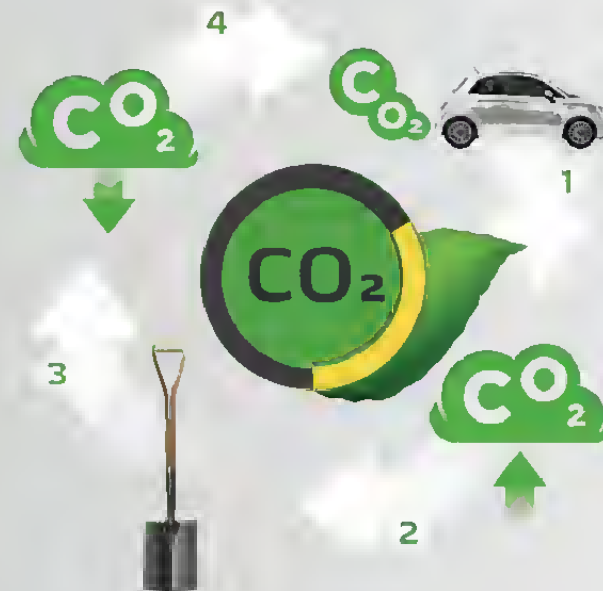
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DIGITAL CLINIC

> BY JOHN HERRMAN

Q+A



Cleaning your gadgets

As someone who likes to keep things tidy, I find my grimy electronics collection is an embarrassment. How can I clean my gadgets without damaging them?

According to a study by the London School of Hygiene and Tropical Medicine, 92 per cent of tested cellphones were contaminated with potentially harmful bacteria, and one in six tested positive for *E. coli*, most likely originating from – yep, everybody does it – bathroom phone fiddling.

But you don't need a microscope to know that gadgets are filth magnets. Dust and grease accumulate on screens with

frightening speed. Hairs and crumbs find cracks, seams and nooks with deadly accuracy. Once-gleaming surfaces fall victim to discolorations of mysterious provenance. Clean gadgets look nice, of course. Sterile gadgets could help you through cold season.

First things first: barring a few speciality items, most of the things you need to clean your electronics are either already in your home or available at a hardware store. "Electronics cleaning cloths" and "electronics cleaner" solutions are re-branded,

overpriced variations on conventional household products. Most of your gadget cleaning can be done with three tools: microfibre cloths or pure cotton cloths, distilled water and isopropyl alcohol.

Cleaning any screen should start with a light, dry wipe-down with a microfibre cloth. (It's best to avoid paper towels, which are more abrasive and prone to dragging particulate dirt across the screen, scratching its coating.) Once the screen is dusted, soak a fresh chamol in distilled water – hard tap water will leave streaks – squeeze it out, and run it across the screen from one side to the other. At the end of every second or third stroke, re-fold the cloth so that a clean portion is touching the screen.

A cloth tainted with abrasive debris will do more harm than good. Wipe any beaded water dry with a fresh cloth. For stubborn finger smudges or layers of tar deposited by smoke, a 50/50 mix of isopropyl alcohol and distilled water will cut through almost anything without being so corrosive as to damage the screen. One caveat: some portable gadgets, such as the iPhone and iPad, have special self-cleaning, or oleophobic, screen coatings that can be damaged by alcohol. With those devices, stick to water. In all cases, keep clear of the very edges of the screens, which are dangerous entry points for moisture. Instead, use a dry cotton swab to remove dirt from recessed edges.

This 50/50 alcohol mix is a do-it-all cleaning fluid. wipe it over keyboards, mice, remotes and other plastic and metal surfaces to quickly kill bacteria and cut dirt and grease build-up. To clear hard-to-reach dust and debris – take a good, hard look between your keyboard's keys – whack it with compressed air, which will blast free all but the most stubborn particles.

One device that deserves special equipment is your camera. Cleaning a lens with a contaminated cloth or a shirtsleeve can degrade delicate lens coatings, so invest in something like the Lenspen, which has a concave chamol tip treated with lens polish, or a similar product. These lens cleaners also come with retractable anti-static brushes for cleaning dust from image sensors; they also happen to be great tools for clearing ventilation grilles in laptops, desktop computers and game consoles.

TOO REAL FOR TV

My new TV is great, with one catch: some movies look weird. Something about the motion is strange, almost as if the movie is animated. What's going on?

Most films are recorded at 24 frames per second, whereas TV is usually recorded at 60 frames per second – more faithful to human vision, but less cinematic-looking. What's causing the effect is something called motion interpolation, which takes low-frame-rate content and converts it to higher frame rates by inserting computer-synthesised frames in between real ones. To turn off this feature, you'll have to figure out what it's called: Sony's version is MotionFlow, LG's goes by the name TruMotion, Samsung labels it Auto Motion, and Toshiba's is ClearScan.

That's not to imply that high frame rates are inherently bad. In fact, Peter Jackson is filming his upcoming adaptation of *The Hobbit* at 48 frames per second, and James Cameron plans to shoot the sequels to *Avatar* at high frame rates as well. As he explained at a POPULAR MECHANICS Breakthrough Awards panel in October last year: "Being able to show movies at 48 or 60 frames a second would really improve the way they look. We've adapted to (low frame rates), and we expect movies to look the way they do, but every time you pan the camera, the whole image strobos." Take heed: in movie technology, where Cameron goes, many others will follow.

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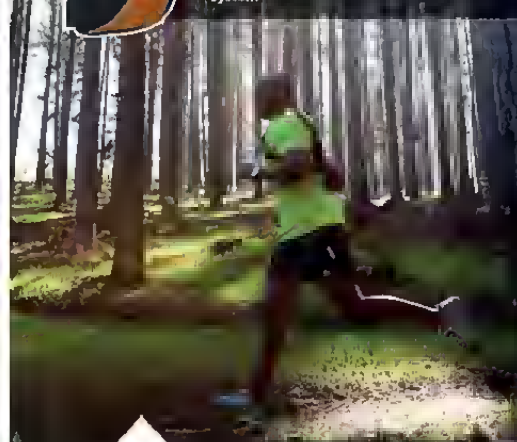
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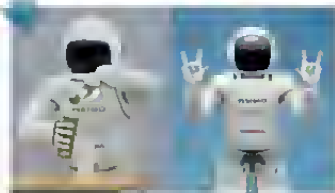


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VIDEO



ALL-NEW ASIMO HITS THE SMALL SCREEN

Honda has unveiled an all-new ASIMO humanoid robot, now equipped with the world's first autonomous behaviour control technology. Scan the QR code and watch as ASIMO prepares and serves refreshments, hops on one leg and runs at 9 kmh...



If you're new to QR codes, read the instructions below and get ready for a fun interactive experience. If you don't own a tablet or smartphone, you can watch both videos on www.popularmechanics.co.za

APPS

PM Daily

We recommend that you waste no time in downloading the PM Daily app and keep up with the latest events and discoveries via our daily sci-tech news service. Enter our regular competitions, browse our "Image of the Week" gallery - we've assembled some exquisite images from around the world - and watch videos to your heart's content. It's available from the Nokia Ovi Store, iTunes App Store and Samsung App Store; search for "Popular Mechanics South Africa".

QR CODE

Step 1: Use your smartphone to download the necessary software from BeTagg <http://bit.ly/2qntkx2>. Install, then launch the application.

Step 2: Select "scan", and the phone's camera will be activated

automatically. Position the phone so that the graphic fits inside the picture frame and hold it steady while the software is activated. (On some phones, such as the BlackBerry, you may need to take a picture of the graphic.)

Step 3: Depending on the device used, this will prompt you to "Open link" or "Go to Web". Follow the prompt to access the above-mentioned videos on PM's Mobile. Download the video to your phone, then watch it. It's as easy as that.

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PM's Mr Mo 2011

We invited you to grow a moustache in November, partly in the name of fun but also to raise awareness of men's health - and prostate cancer in particular. You were asked to upload photos of your mo's to PM's Facebook page by midnight on 30 November, after which we ran the entries past a judging panel looking for the most provocative, most luxurious or most bizarre facial foliage.

Thank you to everyone who participated and voted, and congratulations to **Daniel Jardine**, PM's Mr Mo 2011. He won a Braun Series 3 Wet and Dry shaver worth R1 049.

Runner-up **Jamii Hamlin** won a Schick Hydro 5 Razor worth R50 and the "People's Choice" Award went to **Dawnd Wellenkemp**, who gets a Groom Mate Platinum XL Nose & Ear Hair Trimmer - valued at about R400 - Plus a Schick Hydro 5 Razor.



COMPETITIONS Visit www.popularmechanics.co.za to enter our competitions

Underwater **ARCHAEOLOGIST**

When he was a kid, Chris Southerly wanted to try scuba diving - but the mountains of Virginia, where he grew up, offered few opportunities. So Southerly learned to dive in graduate school, and now it's how he makes his living. As an underwater archaeologist for North Carolina's Department of Cultural Resources, Southerly is currently excavating the infamous pirate Blackbeard's flagship, *Queen Anne's Revenge*, near Beaufort Inlet, North Carolina. When he's not diving to the wreck, he's examining artefacts from the ship to figure out how they fit into people's lives. "An artefact is a tangible connection to our history," he says. "It's one thing to read about it in a book. It's a whole other experience to hold it in your hand knowing that you're the first person to see or touch this object in nearly three centuries." - **MARY BETH GRIGGS**

ON THE WEB > Visit www.popularmechanics.co.za for details of the historic raising of Blackbeard's sunken anchor.



Name: CHRIS SOUTHERLY

Age: 44

Years on Job: 11

Essential equipment:

FULL FACE MASK

→ "In many cases, the waters we're working in have zero visibility," Southerly says. To communicate with fellow divers and the surface crew, he uses scuba gear with a full face mask. Unlike typical scuba equipment, which requires a diver to breathe through a mouthpiece, the mask allows Southerly to talk to other divers up to 45 m away via a radio link.

PORTABLE MAGNETOMETER

→ After using sonar to identify a site, archaeologists deploy portable magnetometers that detect the presence of iron under layers of sediment to pinpoint the best spots for excavation. "Detecting range is based on distance from the object end the magnetic disturbance it causes," Southerly says. "A cannon might be detectable from 4,5 metres, whereas a cannonball may be detectable only from 1,5 metres."

HAMMER AND STAKES

→ "Archaeology is a destructive science," Southerly says. "Once we dig it up, we can never put it back the way it was." Without context, artefacts are nearly worthless, so archaeologists document the site meticulously. Using stakes and synthetic decking boards, they create a 1,5 x 1,5 m grid on the seafloor, then they map the location of the artefacts on waterproof paper.

SLUICE

→ Southerly uses a suction tube to remove small items from the wreck to a sluice, or artificial water channel, on the ship's deck. Send end mud flow with the water until they are discharged at the end of the sluice; heavier artefacts, such as nails or shotgun pellets, drop out of the flow into a separate channel, where they're identified and labelled. Larger items are hoisted up with an electric winch after they've been tagged and mapped on the seafloor.

ONE-DAY PROJECT

Light as iron

COMMON PIPE FITTINGS AND A TOUCH-START SWITCH ILLUMINATE WORK WITH TOUGH INDUSTRIAL STYLE.

BY WILLIAM GURSTELLE

Scrap 20 mm iron pipe, a few fittings and some simple wiring make up this rugged touch-activated lamp.

DIY

1 → PREP. PARTS

Scrap 20 mm iron pipe and fittings make this stable, rugged lamp. Assemble a threaded 30 cm pipe (also known as a nipple), three tee fittings, four 90-degree elbows, one 45-degree elbow, 11 close nipples, four pipe caps, a candelabra socket, a cord, a bulb, a worklight's shade, and a touch-dimmer switch. Use a cobalt bit to drill a 9,5 mm hole in a tee, opposite its centre opening. Pull 45 cm

of cord through the hole and the tee's centre opening.

2 → WIRE THE IRON

Screw together the 30 cm pipe, the 45-degree elbow fitting, and a close nipple. Fish the lamp cord through this assembly. Screw the open end of the 30 cm nipple into the drilled tee fitting's opening.

3 → FINISH THE LAMP

Wire the lamp socket base to the cord at the non-tee end

of the 30 cm pipe. Make sure all electrical connections are insulated and not touching any pipe. Gently pull the cord from its plug end, tightening up slack until the lamp socket base is even with the pipe's edge. Use a hose clamp to clip the work light's shade to the 45-degree elbow.

4 → GIVE IT LEGS

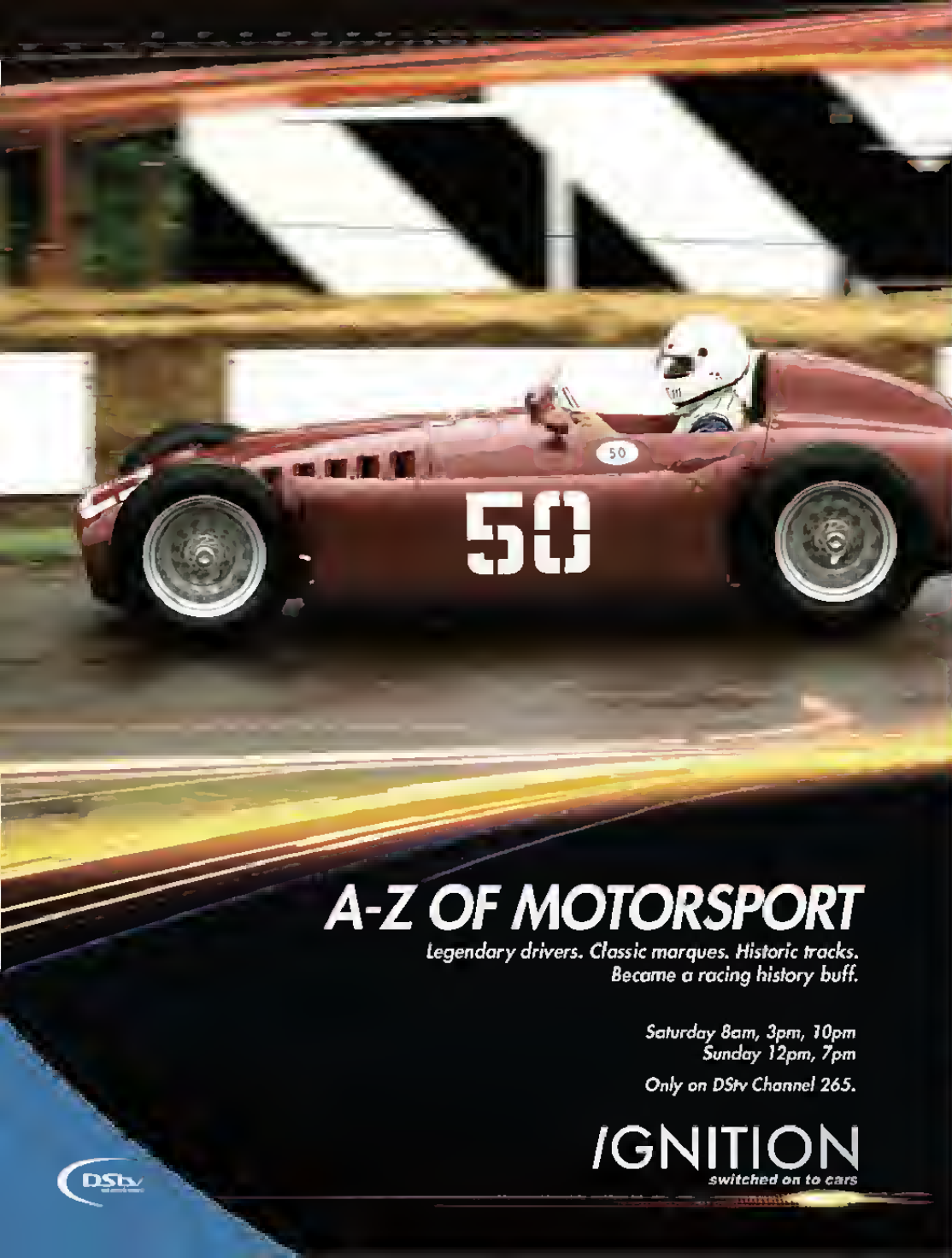
Assemble the lamp base using two tees, four 90-degree elbows, and

10 close nipples. Insert nipples into the openings of the tee and elbow fittings. Finger-tighten the connections. To make feet, screw the pipe-cap fittings to the nipples.

5 → LIGHT THE PIPES

Screw in a bulb. Plug the cord into a touch dimmer and plug it into an outlet. Hit a pipe to turn it on. PM





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SIMPLY *perfect*

This easy-to-build two-door cabinet clears clutter and spruces up a room.

BY JOSEPH TRUINI

➔ **ONE BASIC THING** can make the difference between a room looking cluttered or put-together: storage. Of course, getting rid of excess stuff also helps. But even after you've pared down your possessions, having an attractive place to stash essential items is key. Enter the two-door cabinet, a minimalist solution that's been around for centuries. Our take on the classic fits just about anywhere, and its panels can be made from a variety of materials – metal mesh, glass, or wallpapered plywood, for



example – to suit your decorative palette. Like many PM projects, this one is simple; a reasonably skilled woodworker with a small table saw, cordless drill, and pocket-screw kit could build it over the course of two weekends, max. Here's how.

Cabinet case and doors

Start by cutting the plywood for the cabinet sides, top, bottom, shelves and cleats. I used a table saw, but a circular saw and a straight-edge guide would also do the trick.

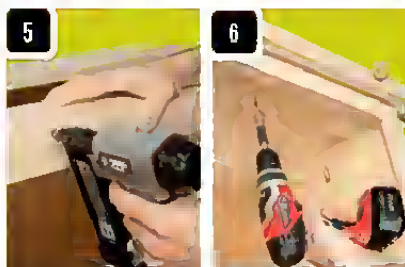
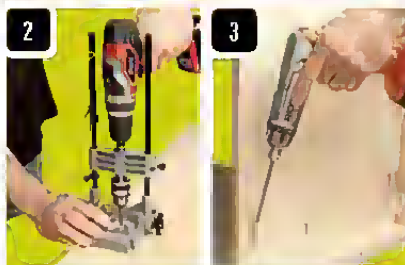
Next, cut the rebate on the inside edges of the side panels with a router and a 10 mm rebating bit [1]. When that's done, use a drill to bore the shelf peg holes in the side panels [2].

Use a pocket-hole jig to make the screw holes in the bottom of the cabinet, then fasten the bottom to the sides [3]. Screw the cleats between the two side panels [4], and complete the case box by cutting the back panel to size and nailing it in place.

Four pieces of wood make up the face frame. Rip and cross-cut these pieces, then glue and nail them to the case using a pneumatic pin nailer (if you don't have one, the manual method works just fine) and 23-gauge headless pins [5]. Put the hardwood edging on the plywood top panel using the same method. Now place the cabinet top – made of material such as trimmed plywood – in position, and drive screws through the cleats into its bottom [6].

Rip and cross-cut the pieces for the doorframes and – again, using the router and rebating bit – cut the panel rebate on the inside edges of the frame. Bore a pair of pocket-screw holes at the end of each door rail, then drive in the screws. Wipe some carpenter's glue on to a pocket-screw plug and insert one into each hole.

Now it's time to choose the panels you'll use. Cut metal-mesh panels to size with suitable snips, slip them into the rebates, and secure with screen moulding nailed to the door frame (see "Panel discussion"). If, on the other hand, you use plywood covered with wallpaper (see preceding page), secure the panel with glass-door retainer clips that you'll find at your local hardware store. Regardless of the panel material, keep in mind that you may need to adjust the rebate depth and width to suit. For thin panels, we found that a



[1] Clamp two panels together for a wider surface and rout the rebate for the back and side panels.
[2] Use a portable drill guide and bore the holes for the shelf pins in the cabinet sides.

[3] Bore four pocket-screw holes in the bottom, then drive pocket screws through the bottom into the cabinet sides.

[4] Cut the cleats to fit between the cabinet sides, and drive counter-sunk screws through the ends into the ends of the cleats.

[5] Simply glue and nail the face frame to the front cleat, the cabinet sides, and the bottom shelf.

[6] The top consists of a plywood panel and three wood edging strips dimensioned to drop down onto the cabinet; it partially covers the top face frame rail, which is 13 mm wider than the other face frame parts. Set the top on the cabinet and drive screws up through the cleats into it.

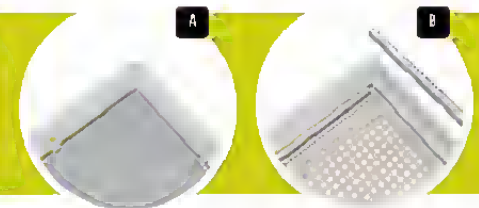
Pictures by Dennis Kleiman



PANEL DISCUSSION

A Solid: Set the panel into a rebate cut on the door's back and secure it with glass-door retainer clips held with screws.

B Metal mesh: Secure the panel with 10 mm x 10 mm beaded screen trim. Drive wire brads or pneumatic headless pins through the moulding's side or front.



rebate 10 mm deep and 13 mm wide works pretty well.

Fasten two self-closing cabinet-door hinges to each door, then lay the cabinet on its back and set the doors on the face frame. Centre the doors on the cabinet with a 3 mm space between them. Bore pilot holes through the hinges into the face frame and screw the hinges to the frame.

Finishing touches

Set a clothes iron at high (cotton), with no steam, and apply iron-on veneer banding to the front of each shelf. Firmly rub the veneer with a wood block to secure the bond. After the veneer has cooled, use scissors and a sanding block, respectively, to cut and hone the veneer to fit.

Fill nail holes with wood putty, let dry,

then lightly sand all surfaces with 120-grit sandpaper. Wipe off dust with a tack cloth, and apply two coats of satin polyurethane varnish. If you'd prefer to stain the cabinet, apply two coats, wait for them to dry, then apply varnish.

Press metal shelf pegs into the holes in the cabinet sides, then set the shelves in place.

PM

DIY HOME

> BY ROY BERENDSOHN

Q+A

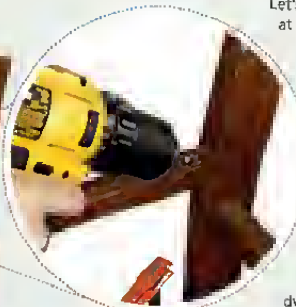
SIT TIGHT

Q At least half of the wood chairs we own are wobbly. We've tried every adhesive we can think of to fix them – white glue, yellow glue, epoxy, polyurethane. Nothing seems to work. What do you suggest we do?

A Glue alone won't work. It's natural to think that it would do the job – like most homeowners, you squirted some glue into a loose joint and hoped for the best. But unfortunately, applying a thick glob of adhesive is actually counterproductive. Wood adhesives work best when you apply a thin film of the sticky stuff to both sides of a joint, then use pressure to force the parts together. Furthermore, you almost always have to rebuild the joint, reinforce it, or disassemble it and remove adhesives from previous repairs to get it to fit properly.

Let's take a closer look at this. For a chair to be moved around easily, it has to be lightly built. Yet the loads a chair accommodates are severe. A chair may weigh 4 to 6 kg, but it has to support a person 10 times its own weight (usually more). And that person is a highly dynamic load. He or she may sit, stand, twist or shift on the chair, putting its joints and parts through strenuous cycles. Compare that with cabinets, chests of drawers and dressers.

This furniture is over-built relative to the weight it holds. A chest or dresser can easily weigh 25 to 50 kg, yet hold less than 15 kg of clothing. Aside from sliding drawers, for most of the time, the



It takes a stubby drill driver or a right-angle attachment to install a pocket screw between a chair's parts. Save space by inserting the bit directly in the chuck rather than in a magnetic bit holder.

load is stationary. You can see why chair joints fail, sometimes catastrophically.

One relatively easy solution for chairs that have only one loose joint is to bore a pocket hole in a discreet location, spread a thin film of professional-quality wood glue on the loose parts, and then drive a pocket screw to lock the joint together. I've done this to a couple of chairs in my house, and I've been pleased with how well the repair has stood up.

This technique won't work if there's adhesive from a previous repair on the joint; it creates an undesirable surface on which to spread new glue. And this works only for chairs with parts that are thick enough or wide enough to withstand the amount of wood that is removed when a pocket hole is bored. Finally, don't use this method on an antique; you could diminish its value.

With a chair that has a number of severely loose joints, label all the parts with masking tape, then disassemble them using a clamp with a reversible jaw, known as a spreader. After you have the parts separated, carefully scrape away the dried adhesive, then repair, rebuild and reinforce the joints. Finally, reassemble the chair using professional-quality wood glue. If you're not an experienced woodworker, take a course at a community college or craft centre before undertaking this project.

REPAIRING GRANITE

Q We have a granite counter with a small chip. Is there a repair material that can fill the damage so that it won't be noticeable?

A You can indeed fill in the damaged area, and once the job is done, it's likely that you'll be the only person who knows the counter has been repaired.

Your best bet is to consult the original suppliers for advice; they might be able to sell you a kit that includes different-coloured tints, adhesives and application tools. You should be able to blend these materials to get a very close match.

"The key when making a repair like this is to overfill the chipped area slightly, then slice off the excess while the material is still moist," according to expert Kevin Thorstad. "Use one of the razor blades from the kit, then let the area cure." The filler dries to a shiny finish; you don't have to polish it to match the surrounding surface.

A professional would probably apply a layer of cyanoacrylate glue (superglue) to the surface of the repair after it's dry and polish the entire counter to blend it in. However, this degree of perfection will cost you; it always does.

ROCK ON

Q I'm a part-time farmer and regularly deal with rock removal. I'd appreciate any information on how I can do this better.

A Several years ago, we took a crash course in rock removal by trying out two new technologies (see the video, "How to blow up a rock in 5 Steps", at <http://bit.ly/rA1MWA>). One was the Micro-Blaster, a small-scale setup that you don't need a licence to use. You take a rotary hammer and drill into a rock, clean the dust and debris out of the hole, and insert a Micro-Blaster cartridge or two into the opening. A pneumatic firing pin detonates the charge. It works like a charm. (Don't forget eye and ear protection.) You can get Micro-Blaster kits through specialty firms that sell to construction and mining companies.

After the fun of blasting and cutting is finished, you'll be left with the hard work of dragging away the rubble. Always remember that your pulling gear is no stronger than the proverbial weakest link, whether that's a Grade 30 chain with a working load limit of 2 000 kg or a piece of rope that breaks when stressed with an unknown amount of force.

I learned the hard way how dangerous rock pulling can be. While dragging a boulder with a four-wheel-drive pick-up, I snapped a high-strength rope, which gave off a crack like a 0,22 rifle. But as startling as that was, it was nothing compared with how viciously the broken rope flew through the air. Onlookers dived for cover. Despite my carelessness, no one was hurt. The first rule in pulling heavy loads is to clear the area of bystanders. A rope that breaks and whips through the air is dangerous, but a flying piece of chain or hook, or a snapped steel cable, is downright deadly.

SEEING SPOTS

Q My lawn sprinklers leave tough, spotty residue on my windows. I've tried glass cleaners, carbonated soft drinks, vinegar and acid-based cleaners that are supposed to remove mineral scale. Nothing works. What else can I try?

A I'd try Spot-X Hard Water Stain & Spot Remover, a cleaner formulated to mechanically (not chemically) remove mineral residue from hard surfaces such as glass, mirrors, porcelain and chrome. Its gentle abrasive action is by means of powdered walnut shell, specifically the *Juglans regia*, or English (European) walnut. In the meantime, you may want to swop those sprinkler heads or adjust their pattern so that they don't spray the windows. PM

PAINT AS YOU GO

Q My husband and I are building a white picket fence to go in front of our house. I'm the painter in our family, and I'd like to be able to take the fence sections into the garage to paint. Can these be made removable?

A I think that's a good idea. Bolting the picket sections to the posts or crossrails would let you take them into the garage to paint when it's raining, for example. I would number the sections to ensure they go back on the posts in the original position.

You should use hot-dipped galvanised bolts to hold the fence sections to the posts. This will prevent rust stains caused by ordinary steel hardware from ruining your paint job. Hot-dipped means that the bolts, nuts and washers are submerged in molten zinc, which bonds to the steel, creating an unmatched electrochemical and mechanical alloy layer. This bond makes the hardware highly corrosion-resistant. Other plating methods – such as tumbling fasteners in hot zinc particles – are not as effective.





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RUNNING on gas

What goes into a gas-powered vehicle, and does converting make sense?

⊕ Gas has been used for generations to run stoves, furnaces, water heaters and other appliances. Vast global supplies are projected to last well into the next century, so it should be no surprise that gas will remain significantly cheaper than petrol on an energy-equivalent measure.

In a properly tuned engine, gas combustion delivers 20 per cent lower carbon emissions and about a 25 per cent reduction in greenhouse gases compared with the



This is no ordinary minivan. It's a Dodge Caravan converted to run on petrol and gas. The high-pressure fuel line can make fill-ups as fast as petrol and cheaper too – but things are complicated.

LPG vehicles globally

cleanest petrol engines, all without damaging existing catalytic converter systems. So right about now you're probably wondering: why aren't we putting this stuff in our cars?

As it turns out, there are very few technological barriers to overcome. In fact, converting existing vehicles to burn gas isn't particularly challenging.

Unfortunately, in many parts of the world, if you tried to do it yourself, you'd more than likely run foul of legislation against modifying fuel systems.

Fortunately, there are certified installers to do the job.

A typical US installer, NatGasCar augments petrol cars by installing a parallel gas fuel system. Their latest creation is a dual-fuel Dodge Caravan intended for airport taxi service. It starts on petrol and switches over to gas once the engine warms up.

NatGasCar's biggest component is also its most crucial and expensive – the compressed-gas fuel tank situated behind the rear seats in the cargo area. The company uses a Type 4 tank, the most advanced kind. It reduces weight with a plastic composite core wrapped in carbon fibre and is rated for severe impact and puncture resistance.

Between the tank and the engine is the fuel regulator, which reduces the fuel-tank pressure of 250 bar to a usable 9 bar delivered to the engine. The fuel regulator is heated to prevent freezing from the expansion of the gas. The lower-pressure gas travels to the engine, Chrysler's flex-fuel-capable Pentastar V-6. A flex-fuel engine is important, since it has hardened valves and valve seats, which are necessary for CNG operation.

The gas is routed through a parallel fuel rail, and a second set of injectors is plugged into a clever adaptor designed to accommodate both the petrol and gas injectors on the same injection port. Gas runs at an ideal air-fuel ratio of about 16.8:1, whereas petrol runs happily at 14.6:1 for the Pentastar engine. As a result, the programming for the new injectors has to be slightly different. NatGasCar's wiring harness intercepts the signals from the engine-control module and, depending upon which fuel is selected, turns on either the petrol or the gas injectors. The signals bound for the petrol injectors are modified to deliver the appropriate amount of fuel to the gas injectors. This way, very little fine-tuning is necessary, and the car's engine-control unit does most of the work.

Country	Vehicles	Dispensing sites
South Korea	2 187 066	1 533
Poland	2 050 000	6 700
Turkey	2 000 000	6 853
Italy	1 002 118	2 350
Australia	620 000	3 200
Russia	600 000	2 000
Mexico	550 000	2 500
India	500 000	550
Japan	292 300	1 900
Netherlands	270 000	1 900
South Africa	About 160*	3

*Before the start of the AIDC project



BITS AND PIECES

UNDER THE BONNET: GAS CONVERSION



LET'S TALK TANKS

All gas tanks must withstand the same standards for impact and puncture resistance as an under-car petrol fuel tank while also vastly exceeding the strength requirements.

(Illustration by Taylor Scott)



WHAT YOU'LL NEED FOR A NATURAL GAS CONVERSION

It doesn't take much besides a new fuel tank to convert a petrol-burning engine to one that also runs on gas, as this typical US installation shows. Attached to the fuel tank (1) is the regulator (2), which reduces tank pressure from 250 bar to 9 bar. Fuel is then fed to a parallel fuel rail (3) and to new, secondary injectors plugged into an adaptor (4). A wiring harness (5) plugs into the factory engine-control unit and intercepts throttle information, sending it to a new fuelling computer (6), which slightly alters the data and passes it to the gas injectors (7) through a parallel wiring harness (8).

THE WORLD PICTURE

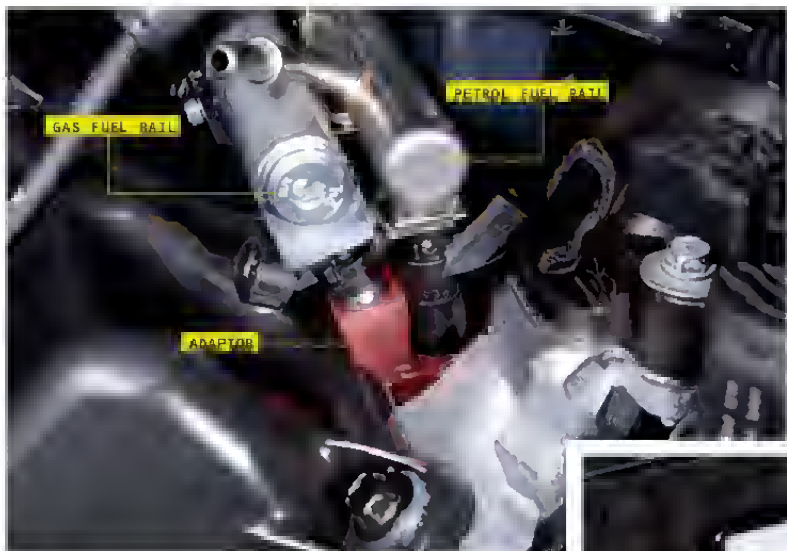
Globally, more than 13 million vehicles run on LPG. South Korea, Poland and Turkey top the list with about 2 million apiece; Poland and Turkey each have about 7 000 dispensing sites, four times that of the Koreans (see table, left).

South Africa's total of fewer than 300 is a drop in the ocean, but the Automotive Industry Development Centre (AIDC) aims to change that. The AIDC has partnered with the national taxi body Santaco and Sasol in a minibus taxi LPG conversion project that is expected to boost our total LPG vehicle park to about 400 vehicles and 9 sites.

Gauteng, which accounts for less than 2 per cent of South Africa's land area, is home

to 44 per cent of South Africa's 7.5 million registered vehicles. Its 32 000 minibus taxis provide the largest carbon footprint in this segment, with about 100 000 km covered a year. They're the most frequent road users, and constantly on the move.

For taxi operators who frequent the LPG conversion route as part of this project, it seems a no-brainer. They get a fully gov-



Two fuel rails and two sets of fuel injectors feed the same port in the intake. The computer starts the car on petrol, and then switches to gas when the engine is warm. The indicator button below is the only clue that this car runs gas.



ernment-funded LPG conversion kit to the value of approximately R15 000 (fully installed) sourced from Voltran in Germany and DT Gas in Poland. They are reimbursed for profit lost during conversion and get the first fill-up free. On top of that, they can expect potentially less maintenance and lower fuel costs.

Accredited installers carry out the LPG conversions (on Toyota Quantum 2.7-litre VVTi petrol models only) in about four hours. A one-year warranty and service plan is included in the deal. Aftercare includes training in how to manage the "new" fuel as well as follow-up on driver satisfaction.

By the start of 2012, an estimated 285

"greener" minibus taxis operating on dual LPG/petrol systems are expected to be plying Gauteng's taxi routes. A total of six filling stations spread across the greater Pretoria and Johannesburg areas will service these vehicles. To cope with maintenance requirements, by December 2011 a total of 40 artisans would have received specialised training.

There's also the possibility of an industry springing up around LPG conversions, kit supplies, servicing and accessories. In time, this could even develop into local assembly of LPG kits.

Price will ultimately determine the fate of gas-powered vehicles. For now, gas has a high price of entry that makes it viable only for taxi services and other fleet operators, but over time, economies of scale may bring down the costs for the ordinary car buyer.

(Original text by Ben Wojdyla, with additional material from the AIDC.) PW

ECONOMY AND EMISSIONS ON TEST

Liquefied petroleum gas, LPG, is a mixture of primarily propane and butane produced as a by-product during the extraction and refining stages of crude oil. When pressurised, LPG is a liquid, but at normal temperature and pressure it will evaporate. The AIDC says that LPG's vehicle-specific advantages include:

- Less carbon buildup, which means longer spark plug life;
- Longer intervals between oil changes;
- Less corrosion and engine wear than petrol engines;
- Lower harmful gas emissions;
- SABS emissions tests of the converted taxis showed an overall drop of 30 per cent in carbon monoxide levels when using LPG compared with petrol. CO₂ levels dropped by 11 per cent. During performance testing at Gerotek near Pretoria, the LPG version was marginally slower than the equivalent petrol-engined model.
- Fuel economy was noticeably worse with LPG – nearly 20 per cent – but lower LPG prices computed to an overall saving of 12,5 per cent on fuel alone.

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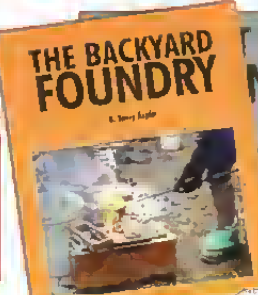
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CHRISTIAN LABUSCHAGNE
RANDBURG

Editor's note: Smite? Doesn't this sort of thing require the jawbone of an ass?

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Getting a grip

Most DIY guys have probably experienced the same problem that I did with keeping their drill's chuck key safe and accessible. The rubber flap where the key is normally

kept generally has a limited lifespan, after which the key goes missing. I stumbled upon the idea of hot-gluing a small magnet (in my case, saved from an old loudspeaker) to the drill in a spot where it does not interfere with your hand; it holds the key very firmly.

KOBUS TERBLANCHE
CAPE TOWN

It happens

Unless you are an incredibly calm and controlled person, a motor accident will leave you shocked and flustered, and you could end up making silly or costly deci-

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sions. Here's how to minimise the risk: find a small card and jot down the names and contact details of your nearest relative, a friendly neighbour, and your doctor, then tape it to your car's sun visor. While you're on a roll, also make a note of your medical aid number and a cellphone number for your preferred towing service. That accomplished, drive carefully.

ANDY CROSS
DURBAN

Oxidation alert!

I was very disappointed when I opened a metal toolbox full of new spanners and other tools to find that virtually every metal object had acquired a veneer of rust – and that after only a few months in the garage. My tip: coat your tools with car wax after use, or place a piece of charcoal in the toolbox to absorb excess moisture (that is, if you can't find any silica gel sachets).

E ROBERTS
CENTURION FM



Beware the democratic imperative

If you think your children are watching too much television, work out a system whereby they "buy" their monthly viewing time with tokens or even real money (refundable). Once their allocation has been used up, off goes the TV. Hint: do not introduce your children to the concepts of fairness and democracy at too early an age. I made this mistake, and now my own viewing pleasure has been curtailed – on the eve of an important sporting event called the Dakar.

BOB LLOYD
CONSTANTIA

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